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OF

NATURAL HISTORY

EDITED BY

HIS GRACE THE DUKE OF BEDFORD, K.G.

BRITISH MAMMALS

BRITISH MAMMALS

AN ATTEMPT TO DESCRIBE AND ILLUSTRATE THE MAMMALIAN FAUNA OF THE BRITISH ISLANDS FROM THE COMMENCEMENT OF THE PLEISTOCENE PERIOD DOWN TO THE PRESENT DAY . . . .

BY

SIR HARRY JOHNSTON, HON. D.SC. CAMB.

AUTHOR OF "THE UGANDA PROTECTORATE," ETC.

WITH SIXTEEN COLOURED PLATES FROM THE AUTHOR'S PAINTINGS, SIXTY-SIX ILLUSTRATIONS FROM THE AUTHOR'S DRAWINGS AND FROM PHOTOGRAPHS ON ART PAPER, AND ONE HUNDRED AND TWENTY ILLUSTRATIONS BY THE AUTHOR IN THE TEXT

London: HUTCHINSON & CO.
Paternoster Row 1903

ACKNOWLEDGMENTS

THE author of this book desires to express his acknowledgments for information, photographs, and specimens to the following persons:—

The Duke of Bedford, K.G., and the Duchess of Bedford; the Lady Boston, of Hedsor, Bucks; Captain R. C. Wilson, of Preston Deanery Hall and Salsey Forest, Northamptonshire; Mr. F. Doggett, Cambridge; Mr. Oldfield Thomas, F.R.S., British Museum of Natural History; Dr. Scharff, Natural History Museum, Dublin; Mr. J. Lewis Bonhote, of Fen Ditton, Cambridge; Mr. Frank Beddard, F.R.S., Prosector, Zoological Society; Mr. A. D. Power; Mr. Ruskin Butterfield; Mr. W. P. Dando, F.Z.S.; Mr. A. J. Sewell, M.R.V.S.; and Sir John Kirk, G.C.M.G.

WOBURN ABBEY.

IT is not every one who has the taste, capacity, or leisure for the scientific study of Natural History. But there are few persons who do not feel that some knowledge of the processes and products of Nature increases the enjoyment of country life. To supply this knowledge in a form at once easily assimilated and scientifically accurate is the object of the WOBURN SERIES OF NATURAL HISTORY.

Each subject will be treated by a writer who has made it his special study. In this volume, therefore, as in all the succeeding volumes, the writer speaks for himself, and the Editor has not attempted to impose his own opinions on those who have been asked to contribute to the series.

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SINCE this book was sent to the press, the following additions to our knowledge of British Mammals have been received :—

An example of the Beluga, or White Whale (*Delphinapterus leucas*), was seen by Sir R. Ll. Patterson off Scarborough on August 19th, 1903 ; and another recorded occurrence of Bechstein's Bat (*Myotis bechsteini*) has been brought to my notice by Mr. Ruskin Butterfield, of St. Leonards. This example of Bechstein's Bat was caught by Mr. J. G. Millais in Sussex.

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H. H. J.

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British Mammals

CHAPTER I

PREFATORY

SOME explanation and apology of and for the presentation of this book to the reading public is necessary, seeing that the subject of British Mammalia has been dealt with before in a general sense by such able writers as the late William Macgillivray, the late Professor Thomas Bell, and Mr. Richard Lydekker; while groups or species of British beasts have been described in detail by Sir William Flower, the late Dr. Dobson, Mr. Oldfield Thomas, Dr. R. F. Scharff, Mr. W. E. de Winton, Professor Boyd Dawkins, Mr. J. E. Harting, Mr. Harvie-Brown, the Rev. H. A. Macpherson, Messrs. W. Thompson (Irish Mammals), Aubyn Trevor-Battye, W. Buckley, John Guille Millais,[1] Lionel Adams, G. Barrett Hamilton, F. G. Aflalo, C. J. Cornish, and Dr. A. B. Smith Woodward.[2] Mr. T. McKenny Hughes in 1896 wrote an admirable treatise on the origin of the breeds of domestic cattle. Mr. F. E. Beddard

[1] The finest draughtsman of British beasts and birds who has yet appeared on the scene. His monographs of the Deer and the Wild Fowl of the British Islands should have been crowned by a British Academy. His study of African Mammals in "A Breath from the Veldt" is unrivalled, and will probably remain so.

[2] Who, together with the late Sir Richard Owen, Professor Boyd Dawkins, and Mr. Richard Lydekker, has done much to describe the ancient mammalian fauna of the two British Islands.

has dealt with Mammalia generally, his work in the Cambridge Natural History Series being the latest study of the subject, and in this book a good deal of incidental information is given regarding the mammals of the British Islands. The admirable work published by Dr. J. H. Blasius in 1857 on the mammalian fauna of Germany and Central Europe contains much information on the structure and habits of beasts which also inhabit Britain; and the great German palæontologist, Dr. Karl A. von Zittel, in his classical *Handbook of Palæontology*, has incidentally described and illustrated a good many extinct British mammals. Students who may be attracted to the study of British mammals are also advised to read the files of such periodicals as the *Zoologist* (London) and the *Field* newspaper, both of which contain first-hand information of great value on British Zoology. To all of the above-mentioned writers and publications the author of this book is greatly indebted for information, and to these separate works he refers such of his readers as are desirous of learning something more about the beasts of their own country, and who might wish for further detailed information connected with the anatomical structure or life-habits of the British Mammalia beyond what can be given within the space of this volume.

To the accumulated and carefully sifted facts recorded by this formidable array of writers the author has ventured to add his own observations and theories. Although a good deal of his time has been spent in Africa, he has nevertheless from his youth up been a student of the British Mammalia in all parts of the United Kingdom. His first interest in British beasts was no doubt prompted by their æsthetic aspect, their beauty of outline or colour; and though he has since become entangled in the fascinations of comparative anatomy, the strongest attraction which beasts and birds still possess for him lies in the part they fill (or should fill) in British landscapes.

It may be necessary to apologise to the world outside Britain for any attempt to attach importance to our existing mammalian

fauna. This has become so reduced in numbers, so scarce and little evident in many of the existing species, that we should almost appoint an annual national day of humiliation for our poverty in this respect, a poverty due to the past ravages of ourselves and our ancestors, and almost unexampled in any other part of the habitable world, except New Zealand or the Pacific Archipelagoes.

This book, indeed, had it only dealt with the few well-known wild beasts still lingering in Great Britain and Ireland, would not have been worth compiling. But the author has endeavoured to deal as amply as possible with recently extinct British mammals ; and to expatiate on the interesting problems concerning the origin and migration routes of the recent mammalian fauna which has inhabited these islands since the close of the Tertiary Epoch. As one drives through the dreary streets of Outer London, or gazes on the devastation of the Isle of Sheppey, the over-building at Bournemouth, the smug villas of Torquay, the paper mills of the Mendip Hills, the factory chimneys of Yorkshire, the desolated bogs of Ireland, and the hideous prosperity of Lanarkshire and Lancashire, it is possible to derive some consolation by recalling in imagination the African elephants and the hairy mammoths, the gigantic wild cattle and clumsy horses, the sabre-toothed " tigers," the lions larger than those now existing, the enormous cave bears, spotted hyænas, gigantic Irish deer, beavers, wild boars, and wolves which severally or together made those regions a scene of fascination and wonder even to Palæolithic and Neolithic man. Like the writers and statesmen of modern Greece and Spain, the author's thoughts as a student of Mammalia are mentally fixed upon the glorious past, and his survey of the present is a whimpering apology. He who would fain have described how the sabre-toothed " tiger " severed the spinal column of the megaceros deer with its trenchant tusks ; how man, naked and unashamed, and armed with weapons which were poor as compared with those of the Congo Pygmy, matched himself against the mammoth and caught the aurochs in a pitfall : he, instead, must twitter on the ferocity of the weasel

and relate park anecdotes of park-fed beasts. There are lessons, however (one must humbly admit), to be learnt even from the nineteen varieties of the wood mouse and the violent amours of the mole.

But as it is the æsthetic aspect of the Mammalia which first attracted the author of this book, it is that on which he most wishes to insist in his arguments. If in any way he has brought home to his readers the importance of Mammalia to the landscape aspects of Britain, the desirability of preserving and strengthening the species that remain (not because they are good for food or sport or unobstructive to the aims of the farmer or the citizen, but because they are beautiful or stimulating to intellectual interest), he will not have written in vain. Man does not live by bread alone. He requires to fill his life with an enjoyment of beauty, a bracing of the nerves by wholesome danger, a stimulation of the intellect by the mysteries of Creation. If we succeed in extirpating our wild beasts and birds, or in reducing a few of them to fattened, pied, frilled monstrosities (an action which will probably proceed concurrently with the extermination of our native flora by field clubs, costermongers, and agriculturists), life in England, Scotland, or Ireland will no longer be worth living, since man cannot live by bread alone, nor can roast beef and potatoes wholly atone for the extirpation of the aurochs and the Osmunda fern. One may admire the pheasant greatly as a beautiful bird, and blind oneself to all peevish evidence brought forward to show that it is not indigenous ; but one should admit that the weasel is quite as beautiful and half again as interesting. Still more, the polecat ; while the wild cat should be permitted to make moderate ravages on live-stock, and the damage done be paid by an interested countryside from out of the rates.

It was distressing to read how, during a yachting cruise in the summer of 1902, the suite that accompanied very distinguished persons gleefully took advantage of their proximity to little-frequented Scotch islands and islets to shoot and leave, kill uselessly without excuse, quite a large number of the few seals which still remain in Scottish waters. The otter is being

rapidly extinguished in Wales, Devonshire, and Sussex, by unreflecting, red-faced, well-meaning, church-going, rate-paying persons on the plea that it eats salmon or trout.[1] Now, what nonsense this is! No trout that was ever served on a dish is as good as a fried sole. Salmon is a handsome-looking fish, so far as fish go, and its flesh, though very provocative of biliousness, is liked by a large number of people. But salmon is produced in such enormous abundance in North America and Norway, and is so very unlikely (owing to its habit of resorting to the sea) to become exterminated in British waters by the otter, that it would be a shame if this remarkable aquatic weasel, so beautiful an object as an adjunct to a stream landscape, were extirpated, destroyed, or even rendered wild, to gratify the angler's craze—a craze nearly as modern as golf and cricket, but not so picturesque or beneficial to athletic development. It is necessary to insist, for the future happiness of the world, on the æsthetic value of beasts, birds, and reptiles. Amphibians and fish are less worthy of regard, partly from the fact that as they live almost entirely in the water they play no part in the beauty of landscapes. As regards all invertebrates, one may disregard, destroy, or disprotect all except those crustaceans that are good for food. Butterflies and some beetles are charming in coloration and outline, but the grandest of butterflies is feeble in æsthetic value compared to a bird, and the grubs of both butterflies and beetles do unmeasured harm. Fresh-water fish should not be protected against the ravages of the higher vertebrates: they must take their chance. As regards sea-fish, many forms are either beautiful in coloration, imposing in bulk, or fantastic in shape, and therefore provocative of interest. But as it is a most exceptional incident in our lives to put on a diver's dress and

[1] Here is an extract from a recent number of the *Daily Graphic*: "The Crowhurst Otter Hounds.—The new pack of hounds which have just been started in East Sussex to hunt the country in the neighbourhood of Hastings is to be called the Crowhurst Otter Hounds. They propose to begin operations on the 18th of this month."

descend below the level of the water, we derive but little æsthetic enjoyment from fish, and though they are estimable as a food supply, their natural domain is so vast that the only mammal who can ever bring any species of them near extinction is man himself.

The present writer has little sympathy with those well-meaning but misdirected persons who, loving the Mammalia, and feeling starved in their affections as British residents, introduce into their parks and domains kangaroos, African antelopes, ostriches, or Indian humped cattle. What they ought to do (what some great landowners have done) is to reinforce and protect dwindling British species, and reintroduce those lost forms which were co-existent with man in prehistoric times, and which may still be found lingering in holes and corners of Europe, Asia, and North America. One does not wish to be unreasonable; and few would propose the letting loose of lions in the hope of re-developing a *Felis spelæa*, or the turning out of Indian elephants to stand the climate as best they might and gradually recover the shaggy hair and the tusks of the mammoth. These creatures, and the spotted hyæna, leopard, glutton, and hippopotamus, might prove too antagonistic to human comfort and prosperity in these crowded islands: we must be content to keep them in menageries. But there is no reason why we should not prudently reintroduce the European bison, the musk ox, the reindeer, the boar; perhaps the bear, the beaver, the saiga antelope, the lynx, and the wolf. We might use all our efforts to stimulate the wild white cattle of the northern parks, forbidding the destruction of red and black calves, and so hoping that, in time, they might regain the stature and appearance of their forefather the aurochs. Horses of the Connemara breed might be encouraged to run wild in paradises like Achill Island and the New Forest till they reverted to the appearance of Prjevalski's horse. Of course, if these islands are to contain a population of (say) a hundred millions, it must be at the expense of destroying all beauty and all specially British characteristics of landscape, fauna, and flora. No doubt, without detriment to the picturesque, the population of Ireland might

be allowed to rise to fifteen millions, and that of Scotland to the same figure, with additional increases to the population of England and Wales, more especially in the existing towns. But the time must come when we shall have to make up our minds, as a nation, to increased emigration towards less thickly inhabited parts of the world, or to the artificial checking of population. Why should we not copy Japan, where a very large population apparently can co-exist with a rich fauna and flora, and with landscapes of superb natural beauty? As regards both animals and plants in that country, the explanation probably lies in the fact that the Japanese have no craze for destroying birds and beasts in the cause of "sport," and no desire to grub up field flowers and transplant them to town gardens. Neither have they developed that worst sign of perverted taste which we display in mixing our flora and fauna. The Japanese develops with care the flora that he finds in his own land. He does not go about planting exotic bushes in his woods and wastes, as we confuse the aspects of English landscapes by rhododendrons and araucarias. In like manner the monkey, which has long since vanished from England, still exists in Japan; while the Japanese bird fauna, commemorated by their unapproached art, has added a notable value to the sum of human happiness.

CHAPTER II

MAMMALS IN GENERAL; AND THE ORIGIN OF THE BRITISH MAMMALIA

MAMMAL is the most convenient term in English to apply to the members of the class Mammalia, the highest development of living forms on the earth's surface. The word, of course, is derived from the Latin *mamma*, a teat, and embodies the most obvious distinction between this group and the other vertebrates, because all the Mammalia nourish their young after birth by a liquid developed in glands which are provided with a nipple or teat.[1] It must be admitted that at present "mammal" is a somewhat pedantic designation, and is certainly never used by the rustic. But it is difficult to see what other term is to be chosen in preference, if accuracy of speech is desired. "Animal" applies not only to mammals, but to every other living creature which is not a vegetable. "Quadruped" is equally foolish, because reptiles (and in a sense birds) also possess four limbs which are usually devoted to purposes of locomotion. The old Anglo-Saxon word *deor*[2] (our English word "deer") has become restricted to a small group of ruminants, and no longer means all the beasts. The English term which comes nearest

[1] Except in the group of the Monotremes, where the liquid of the mammary glands exudes through pores and not through the channel of a nipple. In all the Mammalia except the Monotremes the milk is a sebaceous fluid, but in the case of the Monotremes it would seem to be developed from the sweat.

[2] Akin to the German *Thier*, Latin *fera*, Greek *thēr*.

to mammal in comprehensiveness and accuracy is the word "beast," derived through Norman-French from Latin; but this is somewhat marred by its use as a term of opprobrium among children or its restriction by the agriculturist to horned cattle. Consequently we are obliged to adopt "mammal" as the most correct designation in English for the air-breathing, warm-blooded vertebrates which suckle their newly-born young.

Before beginning a description of British mammals, living or recently extinct, it might assist the unenlightened reader if the author attempted a brief definition of the leading characteristics of the Mammalia as a class. They are warm-blooded, air-breathing vertebrates with a four-chambered heart, with a skin covered usually with hair, wholly or partially; possessing differentiated teeth[1]; lungs freely suspended in the cavity of the chest (partitioned off by a muscular wall from the stomach); red blood corpuscles without a nucleus; and with glands in the skin (usually on the under part of the body) especially developed in the female for the creation of milk as nourishment for the new-born young. They are also marked off from other vertebrates—such as fishes, reptiles, and birds—by the exclusive possession[2] of an outer ear (that is to say, a conch, or flap of skin, muscle, and tendon, which focusses the vibrations of sound on the inner hearing organ); by a heart which has only one aortic arch on the left-hand side (not two arches as in reptiles, or one on the right-hand side as in birds); by the existence of four optic lobes in the brain for the organs of sight; by a lower jaw of a more fused character, with peculiarities as to its

[1] That is to say, teeth not all of one pattern, as in the generality of reptiles, most fishes, and primitive birds, but divided normally into four kinds: incisors for seizing, canine teeth for tearing, premolars for champing, and molars for grinding.

[2] The lowest known forms of the Mammalia, the existing Monotremes of Australia, possess no conch, or external ear, but in all other Mammalia where the conch is not present (as in the whales, certain seals, edentates, and insectivores), there is every reason to believe them to be descended from forms possessing the external ear.

composition and articulation with the skull that are essentially mammalian ; by a skull that lacks several of the many separate pieces of bone that goes to its composition in reptiles and birds. But the last of these obvious distinctions (an invariable one) is the manner in which the skull articulates with the first vertebra of the spinal column. This is by means of *two* separate processes of bone (the condyles), which develop from the end of the occiput, or roof of the skull ; whereas in birds and most reptiles the articulation of the skull with the vertebral column is by means of a *single* process of bone. There is a double process—two condyles—in the Amphibians (frogs, newts, etc.), but these condyles do not arise from the bones roofing the skull.

Then, again, the vertebræ of the mammalian neck are markedly different in shape and structure from those of the back, and the neck vertebræ are almost invariably seven in number. There are not a few other and minor peculiarities connected with the bones forming the spinal column, with the ribs, the ankle joint, the ear bones, and the soft parts (that is to say, the muscles and the various organs of the body) ; but as this book is not a scientific treatise, it would be wearisome to go too deeply into these particulars. The main feature in the Mammalia which sharply distinguishes them from other animals is the secretion of milk by which the young are nourished after birth. In all the Mammalia, except the two existing forms of Monotreme in Australia ;[1] the young are born alive. Mammals, therefore, in the eyes of the undiscriminating differ markedly from birds and reptiles, in that they produce their young alive (from eggs so minute that they are scarcely visible to the naked eye). Mammals are not alone in this feature of living-born young. Some fishes and reptiles, extinct and living, have acquired the

[1] The echidna and the duckbill—very ancient and primitive types of mammal which present a good many reptilian features—produce eggs with large yolks, and these eggs are either hatched in the mother's pouch, or perhaps in the case of the duckbill, allowed to hatch separately from the mother, after which the young animal is placed in the pouch.

habit of hatching the egg within the mother's body and producing living young.

The mammals probably developed from a group of reptiles generally known as the Anomodonts, and these again arose (in common with the rest of the reptilia) from amphibian forms allied to the extinct Labyrinthodonts. The Anomodont or Theriodont reptiles (remains of which are found all over the world, but principally in North America, Europe, and Africa) differed from other known reptiles in the differentiation of their teeth on mammalian lines; that is to say, the specialisation of prehensile teeth answering to our incisors, of tusk-like canines, and of molars and premolars that exhibited three or more cusps in the single tooth. The first mammals were creatures allied in their structure to the Monotremes still existing in Australia. From this stock developed what is known as the Eutherian, or true mammalian form. Among the most primitive of the true mammals were the marsupials, who retain many low characteristics coupled with a certain amount of special development and some degeneracy. At the present day marsupials are limited in their distribution to Australia, New Guinea and the southern islands of the Malay Archipelago, and also to North and South America[1]; but anciently there were marsupials in Great Britain, creatures somewhat resembling the opossums of America and the banded ant-eater of Australia.

When the earth was passing through the first phase of the Tertiary Epoch (the Eocene period), when in fact the British Islands were beginning to assume something like their present relations with Europe (instead of being an outlying part of North America separated from Europe by a shallow sea), the true mammalia were already spreading out into many orders, a few of which are extinct, but most of which have their living representatives at the present day. These existing orders are (1) the *Marsupials*; (2) the *Edentates* (armadillos, ant-eaters, sloths, etc.); (3) the *Whales*; (4) the *Ungulates* (all hoofed mammals); (5) the *Sirenia* (manatis, dugongs, etc.); (6) the *Carnivores*

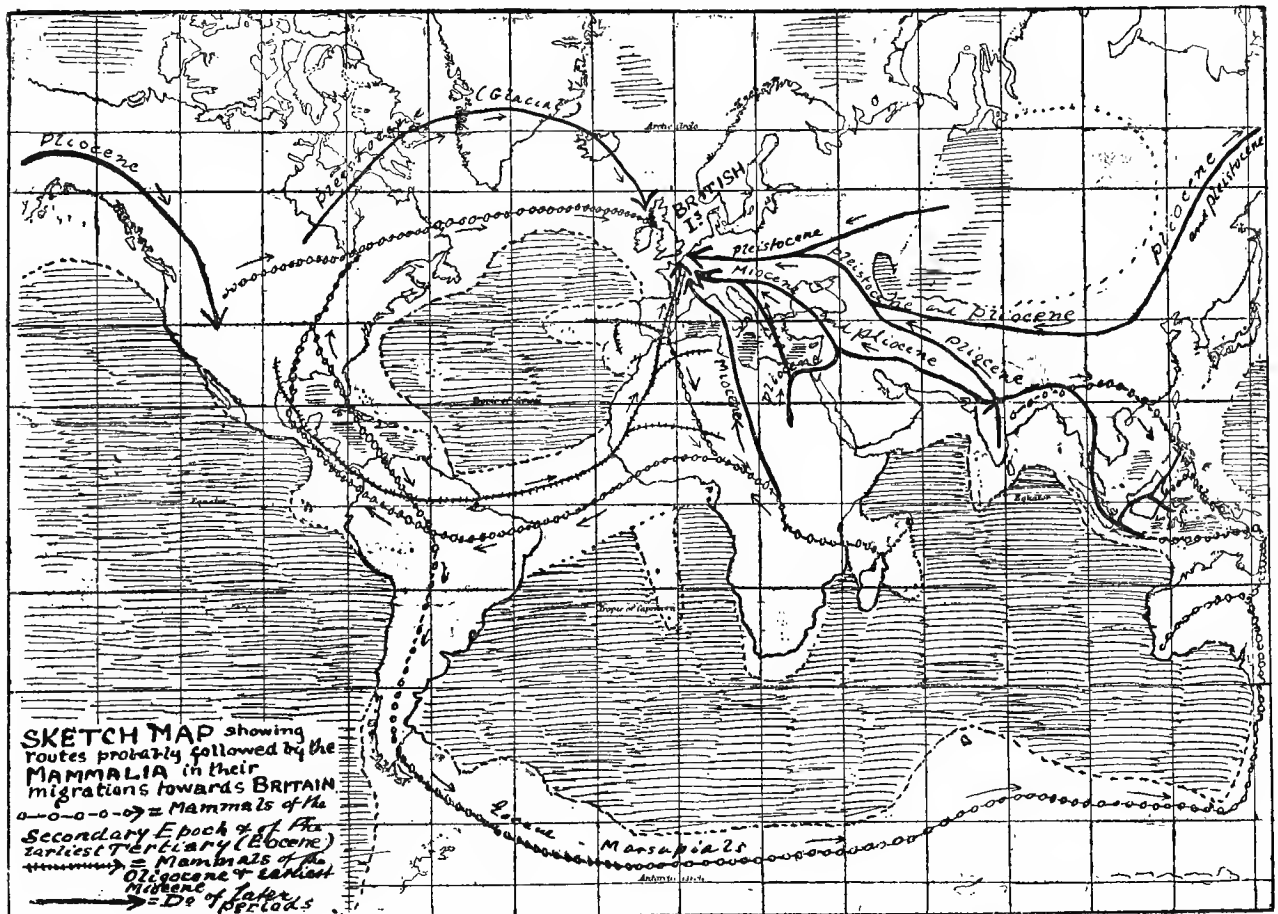
[1] They originated probably in North America.

(creodonts, seals, dogs, cats, bears, etc.); (7) the *Rodents* (squirrels, rats, hares, etc.); (8) the *Insectivores* (moles, hedgehogs, shrews, and their allies); (9) the *Bats*; (10) the *Primates* (lemurs, monkeys, man). The term "order" is of somewhat varying signification in these groupings, but in a work of this description it is unnecessary to discriminate too closely.

The history of mammalian distribution over the British Islands, and the relations of that colonisation with the great areas of mammalian development in the world at large may be summarised as follows :—It is possible that the Mammalia as a class originated in North America[1] or in some region round the North Pole. During the early part of the Secondary Epoch, the backbone of Britain, that is to say, the mountainous regions of Scotland, Wales, and Ireland, possibly formed an outlying peninsula of the North American continent, and from that direction came the first primitive types of monotreme, marsupial, and early Eutherian, remains of which are found in British formations of the Secondary Epoch. No doubt at this time Britain may have been a link connecting the Old World with the New in the Northern Hemisphere, whilst South America was connected through Antarctica with Australia, and later, in equatorial regions, with Africa. This connection of Britain with the Western Hemisphere no doubt ceased to a great extent before the Tertiary Epoch.[2] During the Tertiary Epoch, Scotland and Ireland seem to have been but little favoured in mammalian distribution, whilst England and Wales (connected then with the European continent) shared to a considerable extent in the great mammalian developments of France, Germany, and the Mediterranean regions.

[1] On the other hand, it is equally possible that they may have grown out of Theriodont reptiles in South Africa. But hitherto the remains of the most *primitive* mammals—the earliest known in geological time—have only been obtained in North America and in England.

[2] Except for the northern link by way of Iceland and Greenland, which (especially when reinforced by ice-floes in the Glacial periods) may have enabled a few northern forms to reach Britain from Arctic America.


Pliocene
Pleistocene
(Glacial)
BRITISH Is
Pleistocene
Miocene
Pleistocene and Pliocene
Pliocene
Pliocene and Pleistocene
Miocene
Pliocene
Eocene
Marsupials
SKETCH MAP showing routes probably followed by the MAMMALIA in their migrations towards BRITAIN
= Mammals of the Secondary Epoch & of the earliest Tertiary (Eocene)
= Mammals of the Oligocene & earliest Miocene
= Do of later periods

Though the Mammalia may have originated from reptilian forms in North America (though this is by no means certain), there is no doubt that during the Tertiary Epoch this class had its most wonderful development in India. India would seem to rank first as a focus of radiation, as the region which has developed the most remarkable and numerous mammalians. From India or Southern Asia, as a whole, Europe, Africa, North Asia, North and even South America, received many of their extinct and existing mammalian forms. North America ranks next in importance as the area which has evolved and distributed mammalian types. Indeed, it would seem as if the Primates, the order of which man is a member, originated in North America, and Britain may have been one of the stepping-stones by which the North American lemurs entered Europe, Africa, and Southern Asia. South America was a selfish continent as regards mammalian development. It originated many striking forms of ungulates which lived and died within its limits. It received its monkeys from Africa, but it is doubtful whether it returned to Africa or transmitted to Australia more than a few types of rodents and marsupials.

The value of Africa as a centre of mammalian development is still unknown, because of our great ignorance as to its fossil mammalian types. It is possible, however, that Northern Africa originated the order *Proboscidea* (elephants), and the tropical regions of the continent have no doubt developed special genera of antelopes.

Roughly speaking, since the close of the Secondary Epoch Britain has been dependent for its supply of Mammalia on Germany, France, and Spain. We have really only had the leavings of Central and Western Europe; and, moreover, in the distribution of the Mammalia, Scotland, and especially Ireland, fared miserably compared to England and Wales. This was partly due to the Glacial episodes which afflicted the close of the Tertiary Epoch, and which placed under ice nearly all Scotland and Ireland, and much of Wales. At the end of the Tertiary Epoch the British region richest in mammalian forms seems to

have been East Anglia, which, no doubt, was connected then with Belgium and Holland.

Out of the one hundred and thirteen species known to have inhabited the British Islands from the close of the Pliocene period to the present day, no less than thirty-five are restricted to England and Wales, Scotland being credited with sixty-seven, and Ireland with only fifty. Moreover, in Scotland and Ireland (notably in Ireland) no mammalian remains have been found of an earlier date than the Pleistocene period[1]; whereas in England mammalian remains date from the Secondary Epoch and are found representing all the many stages of the Tertiary.

Of the aforesaid *hundred and thirteen species* of mammals only *seventy-two are now existing* (with any degree of probability) in the British Islands or adjacent seas; and of these *at least fifteen* species (seals, whales, and bats) *are so scarce* or of such doubtful occurrence as to be scarcely worth enumerating in the list of British mammals.[2] *Forty-one species, out of the hundred and thirteen*, have become extinct between the remote days of palæolithic man and the eighteenth century of this era. But of these forty-one, *twelve* are *completely extinct*, while *twenty-nine are still found living* (as scarcely differing species) somewhere in Europe, Asia, Africa, or North America. These are the *narwhal*, the *lesser killer whale*, the *sperm whale*, the *southern right whale*, the *hunting-dog* (*Lycaon*), the *wolf*, the *brown bear*, the *panda*, the *glutton*, the *striped* and *spotted hyænas*, the *lion*, *leopard*, *lynx*, and *Egyptian wild cat*, the *bearded seal*, the *walrus*, the *pika* (*Lagomys*), the *beaver*, the *suslik*, the *lemming* and *banded lemming*, the *hippopotamus*, *wild boar*, *elk*, *reindeer*, *saiga antelope*, *musk-ox*, and *European bison*. Some of these creatures, therefore, might legitimately be reintroduced.

NOTE.—The following table of geological epochs and periods referred to throughout this work in connection with the past history of British mammals may be of use to unlearned readers.

[1] This, no doubt, is a pure accident of geological formations.

[2] So that the total number of species existing within British limits at the present day, is, for all practical purposes, fifty-seven.

EPOCHS

SECONDARY

PERIOD—**Triassic** (The beast-like Reptiles, *Anomodontia*, begin to appear. Mammals of a low, indeterminate, Monotreme type make their appearance in Europe and North America.)

,, **Jurassic** (Birds originate from reptiles at the beginning of this period.)

,, **Cretaceous** (The "Chalk" ages. Forms related to the Marsupial or Metatherian Order of Mammals make their appearance; and perhaps at the close of this period the first types of Eutherian orders—Insectivores, Creodonts, Early Primates, and Ungulates—are evolved. This is the *great age* of reptiles.)

TERTIARY

,, **Eocene** ("Dawn of recent times." Most of the known *orders* [**Oligocene**] of Mammalia accomplish their definite differentiation during this first period of the Tertiary Epoch.)

,, **Miocene** ("More recent." Most of the *families* of the Mammalia are developed during the Miocene. The flora and fauna of England at this time suggest affinities with tropical Asia and Africa.)

,, **Pliocene** ("Still more recent." The modern genera are now developed. The fauna of England and Wales at this time recalls that of modern India, Malaysia, or Africa. Man originates during this period in South-eastern Asia, and spreads westwards towards Britain.)

,, **Pleistocene** ("Most recent." During this period many modern *species* are differentiated. Man becomes established in England, Scotland, and Ireland, and elsewhere all over the world. In the early part of the Pleistocene the mammalian fauna of England and Wales is that of Northern Africa, the Mediterranean, and North Indian regions, gradually changing to a Boreal (Siberian, North American) character, as the icy ages, the Glacial sub-periods, supervene in the British Isles and in much of Northern and North-western Europe.)

QUATERNARY

,, **Prehistoric** (The age of Neolithic man; of the origin of our domestic beasts; and of most *varieties and sub-species* of existing mammals.)

,, **Recent** (From the rise of human history, about eight thousand years ago, to the present time.)

CHAPTER III

ORDER : *CETACEÆ*. WHALES AND PORPOISES

As our review of the British mammalian fauna only commences with the human period—that is to say, the Pleistocene division of the Tertiary Epoch—when most existing mammalian species were developed or developing, no mention will be made here of our long extinct monotremes and marsupials. The first order (on the upwards list) represented in the British fauna is that of the Whales.

The *Cetaceæ* are an order of purely aquatic mammalia, so absolutely adapted to life in the water that it is impossible for them to live and move out of their element. Yet their lives must be spent for the most part near the surface, since they are as much dependent on a supply of air for the oxygenation of their blood as are any of the other mammalia. Any member of the Whale order can be drowned if prevented from renewing its supply of air. Some cetaceans cannot remain under the surface of the water for more than an hour without rising to renew their supply of air, though it is said that some of the larger cetaceans (such as the rorqual whales) can remain below the surface for as much as twelve hours without expiring from lack of air. Whales are further distinguished from all other mammals (except the *Sirenia*) by their complete loss of all external vestiges of hind limbs. In all whales there are minute fragments of bones found isolated in the muscles of the lower part of the body which represent the disappearing structure of the hind limbs, but these vestiges at most only extend as far as a fragment of the thigh bone and sometimes of the tibia (one of the leg bones), all traces of the feet being completely

absent. As regards fore limbs, the hand is usually five-fingered in one great group of the whales (those which retain teeth), and four-fingered in those which have replaced teeth by plates of baleen. The central fingers of some whales develop an extraordinary number of phalanges, or jointed bones. These in the normal mammalian hand are three in number; in some of the whales there are twelve in the central finger. Another peculiarity of whales (shared, however, by some of the aquatic carnivora, and by certain low types of mammals) is the absence of any external ear, though rudiments of the conch are found in the porpoise. Then, again, the teeth of whales differ from most of those of other existing mammals by their complete uniformity, that is to say, they are not divided up into incisors, canines, premolars, and molars. In one or more forms of river dolphin in the Amazon River (South America) there are said to be traces of additional cusps on those teeth which have replaced the molars. This point, however, is not such an important distinction, because we now know through the discovery of fossil forms that ancestral whales (*Archæoceti*) possessed normal mammalian teeth, at any rate so far as the upper jaw is concerned. On each side there were three incisors, one canine, and five molars. Remains of these creatures, which are grouped under a single genus (*Zeuglodon*), have been found in North America, and more doubtfully in England and other parts of Europe, in Egypt, and even in New Zealand.

The next marked stage in the development of the whales is represented by the Squalodonts, in which the teeth are very numerous, and are rapidly approximating to a simple, pointed type; but the molars are still doubly rooted, and their upper surface is notched. The incisors are three on each side, the canines are just distinguishable in form, but the premolars have become simple, single-rooted teeth, and they, together with the molars, have increased in numbers beyond the normal mammalian formula so that in the upper jaw there are as many as twelve of these molar and premolar teeth. Then perhaps next in order of development come the numerous existing

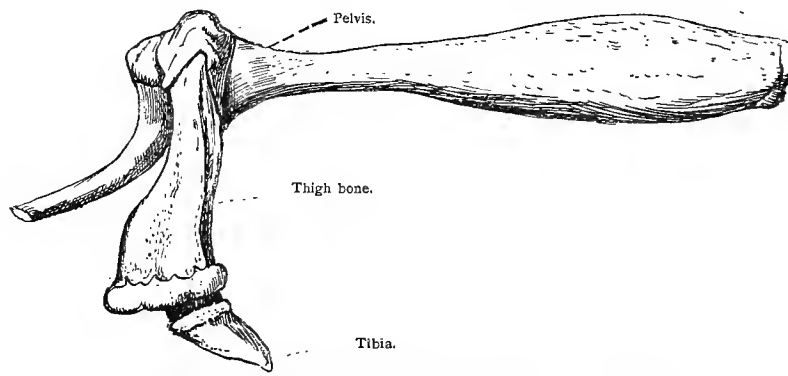
forms of the Toothed [1] Whales (*Odontoceti*). The toothed whales include (besides the extinct Squalodonts) the fresh-water Dolphins, or *Platanistidæ* (relatively small forms found in the Amazon and the Ganges, but in a fossil state also in Europe and North America), the True Dolphins (*Delphinidæ*), the Sperm Whales (*Physeteridæ*), and the Ziphioid Whales (*Ziphiinæ*).

Finally there is the sub-order of the Baleen, or Whalebone Whales (*Mystacoceti*), which differ so markedly from the existing toothed whales that at one time certain zoologists were inclined to believe in the double origin of the whales, that is to say, they would have derived the baleen whales from a different source from that which gave rise to the toothed whales. But this perhaps is due to an exaggeration of the differences between the two great existing groups of the *Mystacoceti* and *Odontoceti*. In the jaws of the unborn young of most, if not all, whalebone whales there are actually two sets of true teeth, the last of which is, however, absorbed into the substance of the jaw before the birth of the fœtus. These two sets of teeth seem to answer to the milk and the mature dentition of other mammalia. In the earliest set of teeth which makes its appearance in the jaws of the fœtal whalebone whale the teeth are much fewer in number than in the succeeding dentition, and they actually offer traces of more than one cusp, thus approximating to the molar teeth of the Zeuglodonts (*Archæoceti*). In this point, as in some others, the whalebone whales offer more archaic features than most of the toothed whales, though in other respects they are a more extreme departure from the ordinary mammalian type. For instance, in the toothed whales the nostrils (except in the fœtus) have only a single opening—the blow-hole—whereas in the whalebone whales the orifice is double, as it is in other mammalia. Also among existing whales the *Mystacoceti* offer slightly more traces of hind limbs than the *Odontoceti*. In the right whale, for instance (from which the best whalebone is obtained), there is not only a minute ischium and pelvis but there is a short thigh bone,

[1] As distinguished from the whalebone whales, which have lost all functional teeth.

and below this a tiny spur which is a rudiment of the tibia, or principal bone of the leg. In the breast bone, made of a single piece (to which only one pair of ribs is attached), in the perfectly symmetrical shape of the skull (both sides being absolutely alike), and in the development of whalebone in the mouth, the *Mystacoceti* differ from the toothed whales. Perhaps their nearest allies in this group are the Ziphioids.

In all whales the mammæ, or mammary glands, are a single pair. They are situated in the inguinal region, close to the vent, and the nipple is concealed in a deep cleft.



ALL THAT REMAINS OF THE WHALE'S HIND LIMBS (*Balæna*).
From a specimen in Museum of College of Surgeons.

Whales are wonderful instances of successful adaptation to a special mode of existence. Originally land animals, they can now exist with comfort under the water at a considerable depth and at very low temperatures. The elaborate network of blood-vessels utilises slowly and with economy the supply of oxygen stored in the lungs; the thick padding of blubber all round the body is an elastic cushion which protects the whale from pressure at great depths or from the effects of cold; so that whales can pass with indifference from the Tropic to the Arctic seas. Blubber is fat (sometimes liquid) held in a dense mesh of areolar tissue.

Owing to their exclusively aquatic existence, and almost equally exclusive confinement in these latitudes to salt water, it

is not as easy, as in the case of land mammals, to definitely include this or that species of whale in the British fauna. Some species not yet recorded as British may occasionally enter our waters within the three-mile limit. In the case of others, their being stranded on British shores after some storm may be the result of a special accident, such as that which occasionally drives North American species of birds to Ireland or Scotland. Up to the present time, however, the species enumerated and described below have been identified in British waters—that is to say, within the three-mile limit—or have been stranded on British coasts.

SUB-ORDER: *ODONTOCETI.* TOOTHED WHALES

FAMILY: *DELPHINIDÆ.* DOLPHINS AND PORPOISES

Monodon monoceros. THE NARWHAL

The Narwhal, or Sea Unicorn, has been recorded at least three times within British limits since the middle of the seventeenth century: once near the island of May (Firth of Forth, Scotland), another time in the Shetland Islands, and on a third occasion off the coast of Lincolnshire (shores of the Wash).[1] The narwhal, in its present distribution, is almost entirely confined to the Arctic regions. It is a smallish whale, not known to exceed 15 ft. in length, turning nearly if not quite white when old, but usually with the upper surface of the body mottled or spotted in dark or light gray on a whitish ground, with the under side entirely white. This creature is famous for its extraordinary tusk. The head is very round, without any projecting beak. The fœtus of this animal has numerous teeth in the jaws, like those of other dolphins; but none of these teeth, as a rule, reach maturity, with the exception of one or two in the front of the upper jaw. In the female narwhal these two tusk-like teeth are quite small, and do not project beyond the jaw, but in the male on one side (usually the left), the tooth develops into an extraordinarily long, spirally twisted

[1] But there are fossil remains of the narwhal, dating from a period just prior to the Glacial periods, found on the north coast of Norfolk.

tusk, perhaps as much as 6 ft. in length occasionally. This tusk grows out horizontally through bone and flesh, inclining towards the middle of the skull. The corresponding tooth on the right side of the upper jaw remains usually quite rudimentary. Occasionally, however, both teeth are developed, though this is a rare occurrence. The narwhal being practically toothless, it is apparently unable to feed on the larger kinds of fish, and its diet is said to consist mainly of octopuses, small crustaceans with soft shells, and small fishes. Scoresby, however, relates that he found the remains of a large flat-fish in a narwhal's stomach, and thought it probable that the male narwhal used his tusk to spear large fish. This, however, seems improbable, since the mouth of the narwhal is too small to take in a fish of any considerable size, even if it succeeded in detaching it from the long tusk, while, as it has no biting teeth, it could not tear off morsels. It is pretty certain that the main use of the tusk is in battles between the males for the possession of the females.

Delphinapterus leucas. Beluga,[1] or White Whale

The White Whale is in many respects a less specialised form than the narwhal, and no doubt represents more or less nearly the stock from which the narwhal evolved. But it has no long tusk. On the other hand, the permanent dentition consists of as many as ten teeth on each side of each jaw—teeth which are simple cones in the young animal, but become, by use, flattened stumps. The young belugas are generally slate colour, fading into grayish-white on the under parts, but the adults become pure white all over—a white which is sometimes tinged with oyster-gray or with a pinkish tint.[2] The beluga is not known to exceed 12 ft. in length.

[1] This is a Russian name, derived from the adjective meaning white.

[2] Nordenskiöld, who saw much of this whale when coasting along the arctic shores of Siberia, describes the adult beluga as singularly beautiful, its glistening white hide showing scarcely a scratch or a wrinkle. Two young male belugas, which were cast ashore in Pentland Frith in 1793, were mottled with brownish-gray, the mottles somewhat resembling the spots of the narwhal.

The beluga has but little more claim than the narwhal to be considered a British mammal. Hitherto it has only made its appearance on the coast of Scotland, some five instances in all having been recorded. In 1879 a specimen was stranded by the tide off a river mouth in Sutherlandshire. The broad tail of the whale had in some way been caught between two short posts which were connected with a net. A dead salmon lying in the vicinity suggested that the beluga had attempted to ascend the river in pursuit of this fish. Indeed, the white whale not infrequently ascends rivers, and appears to have little terror of shoal water.

In both the beluga and the narwhal there is practically no back fin, merely a low ridge standing up along the lower part of the back. Also in common with the narwhal, the vertebræ of the neck in the beluga are separate bones, not fused into a mass, as in most other cetaceans and all other members of the Dolphin family. In these two animals also (especially in the beluga) there is a slight indication of a neck in the outward aspect.

The beluga feeds on such fish as salmon, cod, and flounders, also on cuttlefish and crustaceans. Like the narwhal, it is never solitary, but consorts with others of its kind in small herds. The beluga is unusually playful, not only with its fellows, but even seeming to romp through the water in accompanying ships. This charming confidence, however, is fast dying out, on account of the way in which the animal is attacked by man for its blubber and hide. The beluga, when swimming close to the surface of the water, often emits a bellowing noise when it comes to the surface to breathe. Whalers have named it the "Sea Canary," from the fact of its uttering these cries; but the metaphor is very strained, as, at most, its cry is a sobbing sound, like the faint lowing of an ox. The beluga has been several times caught alive, has been kept in captivity, and become quite tame. One which was captured in the Gulf of St. Lawrence, in the middle of the nineteenth century, was kept alive in a tank at Boston for two years. In the seventh volume

of the *Boston Journal of Natural History* it is stated by Professor Wyman that during its captivity this beluga became quite tame, and allowed himself to be harnessed to a floating car in which a woman performer was seated. The beluga then swam round the tank, dragging the little vessel with him. He recognised his keeper, allowed himself to be handled, and at the proper time would come and put his head out of the water to be harnessed or to take food. This beluga was very playful in disposition. He would take into his mouth a sturgeon and a small shark which were confined in the same tank, and, after playing with them awhile, allow them to go unharmed. He would also pick up and toss stones about with his mouth. In connection with this, it is rather interesting to note that sand and pebbles are often found in the stomach of the beluga, as, indeed, in some other whales. Two other specimens of the beluga lived for a short time at the Westminster Aquarium in 1877 and 1878.

Phocæna communis. The Common Porpoise

The Porpoises differ from the preceding genera in the larger number of teeth which are found in each jaw, and which may extend to as many as twenty-six on each side. The teeth are peculiar in shape, being compressed, spatulate, and sometimes divided into distinct lobes. The tooth is pinched into a narrow neck between the crown and the roots. The porpoise differs from the true dolphins in that it has a relatively round and blunted head, the muzzle of which is not prolonged into a long snout as in the dolphins. It is, like these other animals and unlike the beluga, in the possession of a marked back fin. This fin is remarkable in the porpoise for having often a row of horny tubercles along its margin. These were first observed by the English naturalist, Dr. Gray, who in a specimen caught off Margate noticed that these tubercles were calcified or bony. This was a very interesting discovery. In allies of the porpoise found in the Indian seas these calcified tubercles or scales tend to spread along the whole back of the animal. Moreover, in the

Photo by A. S. Rudland.

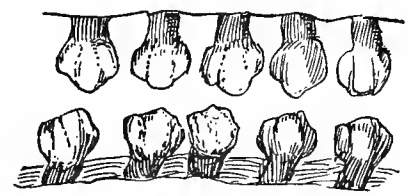
GRAMPUS, OR KILLER (*Orca gladiator*).

From a drawing by the Author.

COMMON PORPOISE (*Phocæna communis*).

To face p. 24.

fœtus of the common porpoise the horny or bony tubercles on the fin are larger and extend further. These tubercles are evidently the last remains of an armature of bony plates which covered the bodies of the early cetaceans. Distinct traces of this armature were discovered by the German naturalist, Johannes Müller, in connection with the remains of the zeuglodon, that primitive whale in which the teeth were still differentiated into incisors, canines, and molars. It is possible, therefore, that when the cetaceans branched off from some stock of primitive land mammals allied to the modern edentates, they, like so many existing edentates, had to a great extent replaced hair as a covering for the skin by an armature of bony plates, hair only remaining here and there on the under parts and about the mouth, in which last position it remains in so many whales in the shape of a few bristles.



TEETH OF PORPOISE (after Flower). Magnified to twice natural size.

The Common Porpoise rarely exceeds 5 ft. in length. The colour of the upper parts is dark grayish-black, with black flippers and tail flukes. The whole of the under parts from the chin to the vent is white tinted with lemon or pink. At the junction of the black of the upper and the white of the under parts there is in many specimens a curiously distinct gray line, as represented in my drawing. The eye in the porpoise is relatively small. The external ear is represented by an opening in the skin so minute that it is scarcely larger than a pin-point. This aperture of the ear is situated about two inches behind the eye, in a line with that organ, and is backed in some specimens by a small wart, the vestige of an ear conch. The porpoise has a voice, though it rarely utters cries except when in sore distress. It is related by Thomas Bell (the author of *A History of British Quadrupeds*) that in the middle of the nineteenth century some porpoises which had entered Poole Harbour made their way up the little River Frome as far as Wareham, in Dorsetshire. Here

they were detained by hastily constructed weirs, and for three days they made such a distressing noise with their bellowing that (with the usual quaint notion of kindness which distinguishes our treatment of the lower animals) they were "put out of their misery," not by being released and allowed to return to their happy life in the open sea, but by being promptly killed.

There is no doubt about the porpoise being a British mammal, for not only is it extremely abundant all round the coasts of Great Britain and Ireland, but it frequently ascends the principal British rivers, not even excepting the Thames. The breeding season of the porpoise is generally supposed to be in the spring, and the period of gestation is said to be six months, but it would seem as though breeding may take place at other seasons, since females with fully developed young have been captured in May. The porpoise only produces a single young one at a birth.

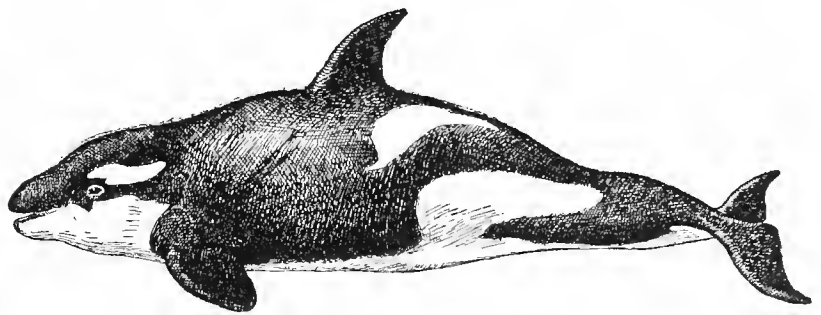
The food of the porpoise consists entirely of fish, usually of the size of mackerel or salmon. The flesh of the porpoise is said to be like pork, and the creature was formerly much eaten in the coast regions of Great Britain, though it has now gone entirely out of vogue. During the middle ages it was an important article of diet, since, being regarded by the Roman Catholic Church as a fish, it was permissible to eat the succulent flesh of the porpoise on fast days. Nowadays its only importance to commerce consists in its hide, which furnishes doubtfully good leather for boots,[1] and for its oil yielded by the blubber. The average porpoise may yield as much as three gallons of oil.

Orca gladiator. The Common "Killer" Whale, or Grampus

This is, in some respects, the most interesting of the British whales, owing to its ferocious disposition, striking coloration, and world-wide distribution. It is constantly met with near the coasts of the British Islands, and occasionally ascends tidal rivers.

[1] Much of the leather known as porpoise hide is, however, made from the skin of the white whale.

Three specimens entered the Thames in the spring of 1890. They swam up the river as far as Chelsea Bridge, and apparently returned to the sea without having been killed by a people celebrated for its love of animals. It is more commonly met with at the present day about the Shetland and Orkney Islands and along the east and west coasts of Scotland. The orca is larger than most dolphins. One specimen killed on the coast of Norfolk measured as much as 21 ft. 3 in.[1] The snout is not prolonged into any beak. The gape of the mouth is not so wide as might be supposed in reference to the ferocious appetite and carnivorous (rather than piscivorous) nature of the animal. The teeth are, as



THE KILLER WHALE (*Orca gladiator*).

compared to the porpoise, comparatively few in number, not exceeding thirteen, and usually as few as ten on each side of the two jaws; but they are slightly curved, pointed, and much larger in size than those of the porpoise or of most dolphins. The longest teeth project as much as three inches from the gum. The coloration of the orca is a bold and eccentric arrangement of black and white, the black, especially over the back, assuming almost a purple tinge. The distribution of black and white is so complicated that it is best illustrated by the accompanying drawing. The Killer Whale has rather large flippers, and a particularly long back fin. This, which is situated rather nearer to the head than

[1] The greatest known length of the orca is stated by Beddard to be 30 ft.

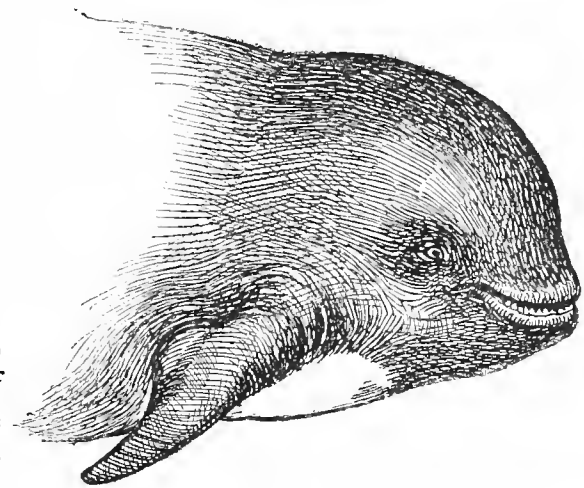
to the tail, is nearly vertical, and is prolonged to quite a sharp, stiff point. But this lengthy development of the back fin is characteristic of the males; in the females it is much shorter. Ancient writers were much impressed with this long, sharp back fin of the killer whale, and started the theory that it was even more rigid and sharp than it is in actuality, and that with this powerful weapon the orca ripped up the belly of the huge whales whom it delights to attack. There is, however, no truth in this story. The killer whales devour seals, porpoises, and dolphins, and attack and eat piecemeal the biggest whales of all kinds. They are said to swallow the smaller dolphins alive, even to the extent of four in succession, and Eschricht, a Danish naturalist, even asserted that in one specimen of the orca which was stranded on the Baltic coast, and which only measured 16 ft. in length, there were remains in the stomach of fourteen small seals. Graphic accounts have been given by Lydekker and Scammon of the way in which the killer attacks large whales, generally aiming first at the mouth and head. It is stated by some that when a whalebone whale opens its mouth the orca dashes in, snatches at and drags out the tongue, which it devours with gusto.

Pseudorca crassidens. The Lesser Killer

This whale scarcely exceeds 14 ft. in length, and has somewhat fewer teeth on each side of the jaw than in *Orca*, those in the lower jaw (ten on each side) being usually more numerous than in the upper jaw (eight on each side). The back fin is much shorter than in the orca, and the flippers are more pointed and less broad; moreover, in colour it is entirely black. This whale appears to be almost universally distributed, having been found (fossil) in England (Lincolnshire), and living on the coast of Denmark, and also off Tasmania. It is remarkable (as a British mammal) from the fact that it was first described from a fossil skull found in the Lincolnshire fens. Some years ago a herd of these lesser killers entered the Baltic, and were described by Danish naturalists.

Globicephalus melas. The Black Fish, or Pilot or "Ca'ing" Whale

This rather large dolphin, at least 20 ft. in length when full grown, is nearly black all over, with the exception of a heart-shaped whitish patch on the throat, which is sometimes extended into a narrow whitish strip along the middle of the belly. It is sharply distinguished from the killers by its very globular-shaped head, which has hardly any projecting muzzle. The flippers are long and narrow, especially towards the tip. They are somewhat "falcated"—that is to say, they are very broad near the base, and then curve like a scimitar towards the tip. The number of the phalanges, or small bones, in the two middle fingers of the flippers may be as many as fourteen. The back fin is depressed, and not erect as in the orca. It is long and thick. The teeth are small in size, and mainly confined to the front part of the jaws, never exceeding twelve on each side.



Head of Black Fish (*Globicephalus*).

This whale is of a mild disposition, entirely lacking the ferocity of the killer. It feeds mainly on cuttlefish, though it also devours herrings, mackerel, and other fish of small size.

The Black Fish is often seen off the British coasts. In different varieties or species it is very nearly world-wide in distribution, though it does not extend very far into the Arctic regions. Its most common habitat in British waters is the sea

round the Orkney and Shetland Islands. The black fish is said to be the most gregarious of all known whales, assembling in large herds, which are believed to include sometimes from one to two thousand individuals, though more commonly not exceeding two or three hundred. These herds follow a leader, and follow this leader blindly, even though it may be into shoal water, where they become stranded. In 1845 it is stated that two thousand and eighty of these black fish were driven ashore by the fishing fleets on the Faröe Islands; and in the same year, on September 22nd, fifteen hundred and forty were killed in two hours in Quendall Bay, Shetland Islands. "Should one whale break through the line," writes Bell, "all is lost: the rest will follow it out to sea in spite of every exertion of the fishermen; but if they are forced into shallow water they plunge blindly on till they strand themselves, and then the whole population rushes wildly at them, armed with harpoons, spears, hatchets, picks, spades, and any weapon that comes to hand; and the cries and dying struggles of the poor animals, the shouts of the men, and clash of weapons, the bloody and troubled sea, combine to form an extremely exciting if somewhat revolting scene."

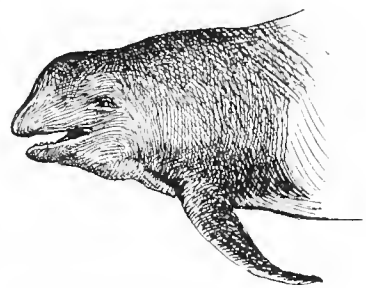
The young of the black fish is 3 ft. long at birth, and is generally born towards the end of summer.

Grampus griseus. Risso's Grampus[1]

This whale, which is very rarely taken in British seas, is distinguished from all other dolphins by the total absence of teeth in the upper jaw, while in the lower jaw the teeth are sometimes as few as three on each side, or as many as seven. In the configuration of the head it somewhat resembles the black fish, though there is a greater extension of the snout. The flippers are long, but much narrower and less falcated than in the black fish. The length of the animal rarely exceeds 13 ft. The coloration is rather peculiar. The head and fore part of the body (except the flippers) is gray, with mottlings and lighter

[1] The English word grampus is simply a corruption of the French "grand poisson." It is a name often applied to the orca, or killer whale.

patchings. The back, the back fin, and the tail are blackish, almost purple in parts; so also are the flippers. The under parts are grayish-white; the sides are grey, sometimes tinged with yellow; and the flippers and much of the body are strangely marked with whitish spots, streaks, and scratches, giving the creature the appearance of its glossy hide having been scored by the body being dragged over pebbles. The food of this grampus is mainly cuttlefish. Its distribution is pretty general, though it seems to avoid the Arctic regions. As regards its frequentation of British waters, it has been most commonly met with in the British Channel, between Devonshire and Kent, though it has also been recorded in the Solway Firth and off the Shetland Islands. A specimen caught near Chichester in 1875 was exhibited for a day or two at the Brighton Aquarium.



HEAD AND FLIPPER OF RISSO'S GRAMPUS (*Grampus griseus*).

Lagenorhynchus albirostris. THE WHITE-BEAKED DOLPHIN

The genus *Lagenorhynchus*—"short-beaked" dolphins—includes a group of several small cetaceans which are thought to connect the beakless forms previously described, in which the muzzle is very short, with the long-snouted true dolphins, where the muzzle is often prolonged into a form like the beak of a bird in outline. In the short-beaked dolphins there is very little break in outline between the forehead and the muzzle. In the White-beaked Dolphin the upper jaw is rather shorter than the lower. The teeth are small, and may be as many as twenty-six in number on each side of both jaws. The adult white-beaked dolphin is from 8 ft. to 9 ft. long. One specimen captured on the coast of Norfolk measured 8 ft. 2 in. This dolphin is very handsomely coloured, the upper part, including the flippers and the tail, being deep purple-black. The sides are grayish, and the belly, throat, under jaw, and the greater part of the

upper jaw are cream-white. On the gray sides there are three or more large spots of whitish colour, which, however, are often broken up by mottlings of a darker tint. There is also a light patch on the back of the head behind the blow-hole, and another near the root of the tail. The back fin is long and pointed, and slopes backwards. In the living animal the black area of the back is really a rich purple, almost iridescent. The skin is of a soft and silky texture, and so thin that it is easily rubbed off.

This dolphin is an inhabitant of the seas of the North Atlantic and the coast of America and of Europe. About six specimens have been obtained at different times on the west and east coasts of Scotland. One at least was captured on the north coast of Ireland, and the remainder of the examples were obtained on the east coast of England from the Tweed down to the vicinity of the Thames. The white-beaked dolphin is also found in the Baltic Sea.

Lagenorhynchus acutus. THE WHITE-SIDED DOLPHIN

This rare form, distributed sparsely about the coasts of the North Atlantic, only seems to have made its appearance in British seas in the vicinity of the Orkney Islands, where it has been obtained three times, including its first description from a stranded skull. It is also stated that it has been met with in the Hebrides. It is perhaps a little smaller in size than the preceding species, and its distribution of colours is pretty much the same, except that the whitish areas on the flanks of the white-beaked dolphin become a continuous white band in *Lagenorhynchus acutus*, which feature gives it the name of the white-sided dolphin. This white stripe on the flanks extends nearly the whole length of the body, from the flippers to the vicinity of the tail, but away from the middle of the body the white stripe becomes yellowish or even brown. There is sometimes a dark line lying within this long band of darker colour. This dark line starts from the right of the tail and ends on the upper portion of the white patch on the flanks. The mixture of white, yellow, brown, and purple-black gives this dolphin a very handsome appearance.

Delphinus delphis. The Common Dolphin

The Common or True Dolphin and all the members of its genus are distinguished from the other members of the family by their pronounced beak. This is a considerable prolongation of the skull, rendered the more striking by the great accumulation of fatty blubber in front of the forehead. In the shape of its skull and jaws the dolphin is more primitive than the other genera of its family, and represents more nearly the original cetacean skull, which in the earlier types of that group was very prolonged. The jaws are sometimes furnished with as many as sixty-five teeth on each side—seldom less than forty. The dolphin, therefore, has more teeth than any other mammal. The neck vertebræ are less fused, and are more distinctly developed than in the porpoises and killers. The flippers, or front limbs, are rather long and pointed, sometimes almost hook-like in outline. The back fin is well developed, but broad, and not so pointed as in the short-beaked dolphins. The eye in the true dolphins is relatively large (with a white pupil), the ear being represented, as usual, by the tiniest pin-prick. The coloration of this creature is beautiful, and its appearance is somewhat like watered silk. The upper parts, as usual, are black, the flanks are striped in ochre and yellowish-gray, and the belly is white. The lips are bordered with stripes of lead gray. The remarkable striping and spotting are best illustrated by a drawing.[1] The total length of the common dolphin is probably not more than 8 ft. The dolphin only produces one young one at a birth. To this the female devotes herself with the greatest tenderness and care. The mammary glands, which are situated near the vent, and of course in the lower part of the body, become very much enlarged and projecting when the young is born, while

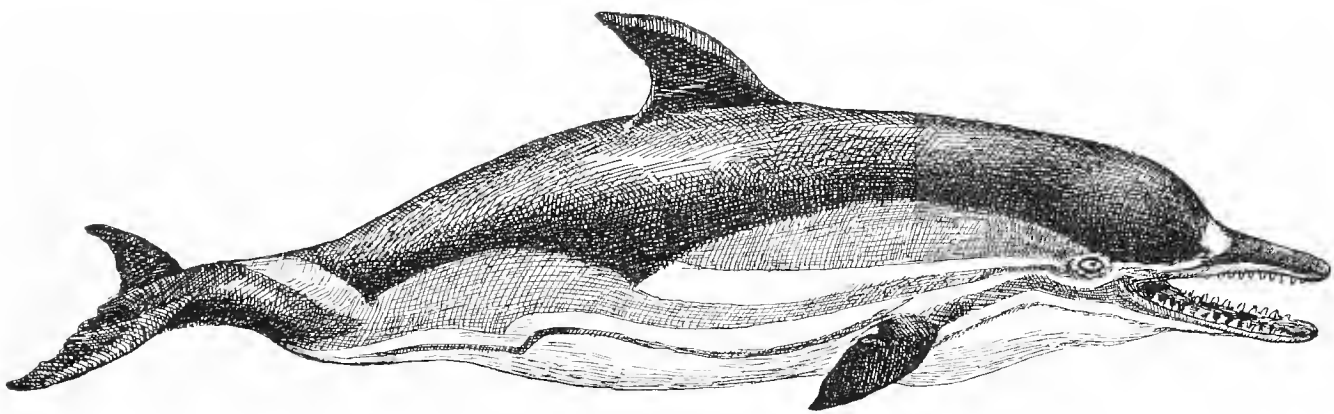
[1] This appearance of watered silk sometimes almost takes iridescent hues in the living animal; but it is scarcely necessary to point out that the dolphin of poetry, which passed through a gamut of exquisite rainbow hues as it died, was not this or any other cetacean, but a large fish (*Coryphæna*) which is found in the Mediterranean and Atlantic, and which has often been mixed up with the dolphin in heraldry.

the teats, which at other times are concealed in folds of the skin, stand out, much swollen. The milk is said to be abundant, and very rich.

The dolphin is not one of those cetaceans that frequent the Arctic regions. It is very rarely met with as far north as Southern Greenland, and it is not common off the coast of Norway. The chief home of the common species appears to be the Mediterranean, though it also extends across the North Atlantic. In British waters it frequents the Channel more than the North Sea, and in the Channel it is very common. Its food is fish, especially herrings and mackerel, and also jellyfish, small cuttlefish, and crustaceans. It seems to be a creature of happy disposition, perpetually romping in the water, and by no means afraid of man. It constantly accompanies ships in large herds, and, indeed, is more commonly seen even than the porpoise. Like its congeners, it has a voice, which it is said to use in a gentle lowing sound.

Tursiops tursio. The Bottle-nosed Dolphin

The Bottle-nosed Dolphins differ from the true dolphins by their somewhat larger size, and by the much shorter and less prominent beak. This creature is very under-hung, the upper jaw being quite short as compared with the lower jaw, while the opening of the mouth begins much higher up in the head, suggesting a faint resemblance to the whalebone whales. The teeth are fewer than in the true dolphin—about twenty to twenty-five on each side of each jaw. These teeth in the adult animal become worn down to flat surfaces, except perhaps in the case of one or two in the front of the jaw which retain their conical shape. In colour the bottle-nosed dolphin is purplish-gray above and gray or grayish-white on the under parts. The flippers are shorter than in the common dolphin, the back fin is rather long, but blunt-tipped. This creature is said to have a powerful voice, like the bellowing of a bull. The range of the bottle-nosed dolphin is very much that of the common dolphin, but in British waters it is a much rarer animal. Specimens have been obtained during the last hundred and twenty years from the Thames and



COMMON DOLPHIN (*Delphinus delphis*): to show markings. Note the white iris of the eye.

the coasts of Devonshire, North Wales, Lincolnshire, Scotland, and Ireland.

FAMILY: *PHYSETERIDÆ*. SPERM AND ZIPHIOID WHALES

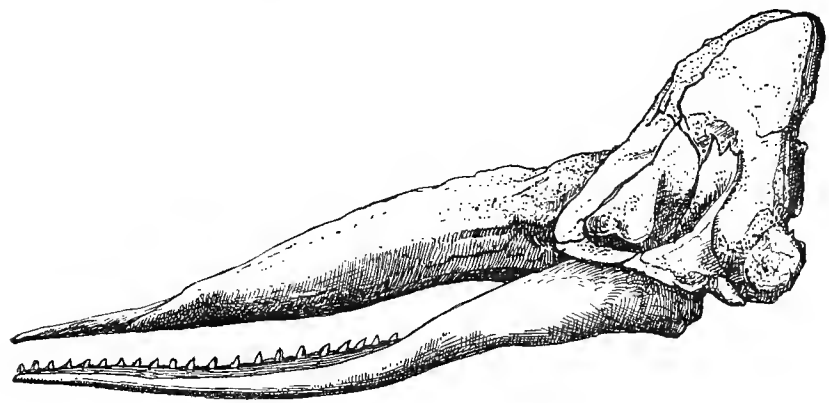
This family is supposed to differ at the present day from almost all the dolphins in that there is an absence of functional teeth in the upper jaw. This is perhaps rather a foolish distinction, since, apart from the similar case occurring in Risso's grampus, we now know that in one genus at least (*Kogia*) of sperm whales there are two functional teeth on each side of the upper jaw, and in most of the Physeteroids there are rudimentary teeth in the upper jaw which do not cut the gum. Moreover, remains of fossil sperm whales in Europe and South America show that in these earlier types there were teeth in both jaws. But the Physeteroids also differ from dolphins and from other whales in the remarkable construction of the back portion of the skull, which rises into a high ridge or crest behind the nasal aperture. This family is, or was, represented in British waters by the sperm whale and the beaked whales.

SUB-FAMILY: *PHYSETERINÆ*. SPERM WHALES

Physeter macrocephalus. THE SPERM WHALE, OR CACHALOT

This has perhaps in its time been the most gigantic cetoid development in size, for there are credible stories, supported to some extent by the evidence of teeth, that sperm whales, 80 ft. long existed in the Pacific off the coast of South America. But at the present day the largest known males have not been found to attain a greater length than 60 ft. The female sperm whale is proportionately much smaller than the male, being scarcely over 30 ft. long. The True Sperm Whale has an enormous head, in length about a third of the total length of the body. There is a marked prominence at the back of the head, which corresponds (though there is a great mass of blubber behind) to the great upward development of the crest of the skull in the Ziphioids. The blow-hole, or outer valve of the united nostrils,

is carried much further forward than in any other existing whale, and is immediately over the tip of the upper jaw. The lower jaw is quite slender towards its tapering end, but the upper jaw terminates outwardly in an enormous truncated mass, rising vertically above its attenuated bony termination. This truncated snout is flat and broad, and its termination is almost square with the sides of the head, though it is somewhat rounded above. There is no indication of this extraordinary development of gristle, flesh, and blubber in the skull of the sperm whale. From the attenuated upper jaw one would argue a long, thin beak instead of this gigantic snout, in shape like a huge travelling



SKULL OF SPERM WHALE (*Physeter macrocephalus*).

bag. The eyes are placed not very far from the angle of the jaw, and relatively close to the eye is situated the flipper, which must be of little functional use to the sperm whale. All the neck vertebræ are fused together, and the neck is extremely short. In the attachment of the ribs to the vertebræ, the double head of the rib may rest on a single vertebra. The blow-hole, or outer termination of the nostrils, which, as in all the Odontocetes, is a single opening, lies on one side of the termination of the snout, and not exactly in the middle. This makes the upper surface of the skull markedly asymmetrical. The aperture of the blow-hole is almost in the form of the letter S.

In the narrow lower jaw the number of teeth may be as many as twenty-five. The two diverging bones which form this mandible are united for more than half their course, and are not widely separated from their junction at the chin, as is the case with most other cetaceans. In the enormous cavity between the bones of the skull and the upper surface of the trunk-like head is an accumulation of oily matter—spermaceti—secreted by the lining membranes of the great cells that surround the long passage running diagonally through this huge excrescent growth from the openings of the nasal bones in the front of the skull to the outlet of the nostrils at the end of the snout. This whitish oil, which is secreted on either side of the passage of the nostrils, has been in use for hundreds of years for many purposes. Its origin and nature were at first misunderstood by the ancients, who thought that it was the seminal fluid of the whale and therefore called it "spermaceti." The thick blubber which lies all along the back of the sperm whale also produces a most valuable oil, and for these two products (together formerly with ambergris) the sperm whale has been hunted well-nigh to extinction. Ambergris, which is found in its intestines, and which, when expelled therefrom, floats on the surface of the sea, is a gummy substance in which are embedded the beaks of cuttlefish. This substance is used in perfumery, and anciently was thought to be a strong aphrodisiac. The sperm whale has no back fin, but along the line of the back there are a series of lumps and undulations. The largest of these, which rises in the middle of the back over the junction of the tail and the body, is almost prolonged into a fin-like excrescence. The colour of the cachalot, or sperm whale, is black, shading into a grayer tint on the belly. Its food consists mainly of squids and cuttlefish. It also eats such fish as come in its way.

The cachalot was formerly world-wide, with the exception that it avoided the icy seas of the Arctic and Antarctic regions. Sperm whales were repeatedly cast ashore on the coasts of Britain in preceding centuries, the last occurrence, however, being no farther back than 1871, when a large specimen was stranded on

the island of Skye. But in a more remote period in the history of this species, sperm whales closely allied to the existing form were common in English seas, and their remains are preserved in East Anglian rocks of the Pliocene period.

SUB-FAMILY: *ZIPHIINÆ*. ZIPHIOID OR BEAKED WHALES

A small Physeteroid or sperm whale (represented by the genus *Kogia* found in the Antarctic seas, and not much larger in size than a porpoise) forms some link between the huge sperm whale and the outwardly very dissimilar remaining members of the *Physeteridæ*, who are grouped together as a sub-family, *Ziphiinæ*. In the Ziphiines there are no functional teeth[1] whatever in the upper jaw, and in the lower jaw the teeth are reduced to one pair, or more rarely to two pairs. These scanty teeth sometimes become very large in the males, and are perhaps used for fighting in some species. A marked feature in the Ziphioids is the extraordinary development of crests of bone behind the ear or in front of the nasal openings at the top of the skull. These bony crests support great bulging foreheads of fatty tissue containing spermaceti. They are even more exaggerated in the male than in the female. The upper jaw is prolonged into a long and narrow beak, usually not much, if at all, under-hung by the lower jaw. In nearly all the Ziphioids there are marked longitudinal grooves on each side of the throat. All possess a small back fin. The blow-hole is single, shaped like a crescent, and usually in the middle of the huge bulging forehead of fatty tissue.

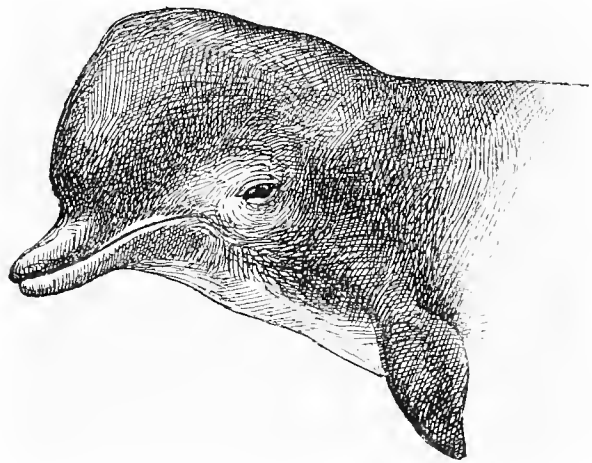
The stomach of the Ziphioid whales is a peculiar feature, and contains a great many compartments, sometimes as many as fourteen. All the Ziphioid whales, being, for masticating and snatching purposes, practically toothless, live entirely on cuttle-fish and small, soft-shelled sea animals. Indeed, it is no doubt this diet, so much affected by many groups and species of whales, which is gradually causing the disuse of the functional teeth. All these Ziphioids with whom man has come into

[1] That is to say, the teeth practically never pierce the gums.

contact are stated to possess loud voices, which they use when in distress, and which resemble the bellowing of oxen, or even loud, human-like sobs.

Hyperoodon rostratus. The Common Beaked or Bottle-nosed Whale

This animal attains to a length of from 20 ft. to 26 ft., males even perhaps as much as 30 ft. The upper jaw is prolonged into a short beak, and above the beak rises a huge, dome-like forehead, supported not only by the premaxillary crests of bone which rise from the base of the skull, but also (in the males) by two still huger excrescences of bone growing up above the eyes in a pyramidal shape. This growth of bone in the males, and the consequent exaggeration of the bulging forehead, almost covers the beak, which is much more apparent in the females and in the young. The teeth are reduced to a small pair, conical in shape, at the extremity of the lower jaw, but these even are covered over by the gum, so that the creature during its life is practically toothless. The tail is not notched in the middle between the flukes, but has a perfectly straight outline along its extremity. In colour the bottle-nosed whale is black above and grayish-white beneath, but with advancing age turns to yellowish-gray all over, with a white band round the neck and white on the front of the head and upper jaw. The beaked or bottle-nosed whale is never found in herds, but goes about



Head of Bottle-nosed Whale (*Hyperoodon rostratus*).

singly or in pairs. This whale is still found pretty frequently in British waters. One was caught in the Thames above London Bridge in 1783, and nearly a hundred years afterwards (1882) a pair entered the Thames and were killed there. It is of very common occurrence round the Shetland Islands, and is frequently stranded on the coast of Norfolk and along the British Channel.

It is curious that this whale appears to be unknown elsewhere in the west of Europe than on the coasts of the British Islands and of Northern France. Its chief area of distribution at the present time is the Arctic Ocean. It, or a closely allied species, is found fossil in East Anglia.

Ziphius cavirostris. Cuvier's Whale

This remarkable creature is very rare, only one example having been found in British waters (off the mainland of Shetland). In Cuvier's Whale the lower jaw, when covered by its integuments, is larger and more prominent than the upper jaw, which it overhangs. There are two conical teeth in the lower jaw, placed in the front, so that when the jaws are closed these teeth project in front of the muzzle of the upper jaw. Some specimens of this Ziphioid from the Mediterranean are stated to have the skin of the jaws set with hard bony tubercles. In the skull of this animal there are but slight indications of the bony crests so common in most of the other Ziphioids. The colour of this whale appears to be uncertainly known. It is possible that it is dark gray above and whitish on the belly, with the dark gray portion of the body marked with irregular white streaks.[1] *Ziphius* in one or more species is (however rare) of world-wide distribution, having been met with off the coast of South Africa and of South America, New Zealand, and the Mediterranean.

[1] These whitish streaks and scratches, found on the thin outer skin of so many Ziphioids and Dolphins, are said to be due to blisters caused by the sharp suckers of cuttlefish.

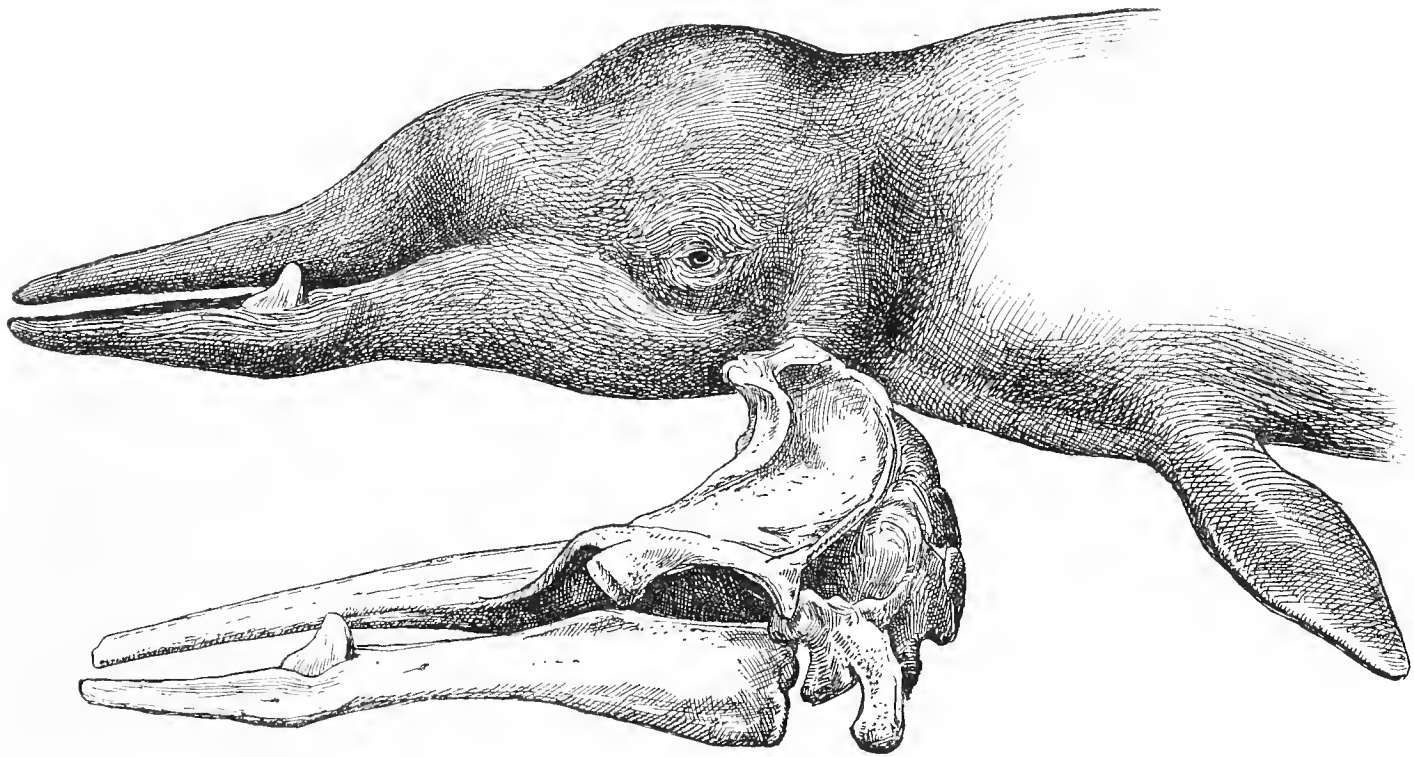
Mesoplodon bidens. Sowerby's Whale

In this animal (about 15 ft. long) there are two functional (and rather large) teeth growing out of the middle portion of the lower jaw. In the males these teeth are sometimes considerably developed, and always show like the tusks of a boar when the mouth is closed, as they diverge from the edge and project outwards. Under the throat are two diverging furrows somewhat in the shape of a V, with a point directed forwards. The opening of the ear in this animal is so small as to admit only a fine bristle being passed through it. Sowerby's Whale is dark blackish-gray, or sometimes a bluish-slate, with the under parts of the body much lighter, and the surface of the body is also diversified with small whitish spots and streaks. The nostrils open not at the bottom of a deep hole just above the base of the beak, but directly on the top of the skull, in a slight depression. This Ziphioid was first made known to science by a specimen cast ashore on the coast of Elginshire (Scotland). Since that time a number of other specimens have been stranded on the Scotch or English coasts, or have been captured at sea close to the coast-line. This whale would appear mainly to frequent the Atlantic, and to range perhaps as far south as the Equator. In the southern seas it is represented by closely allied species. In a very distinct form of this genus in South African waters, the teeth in the lower jaw appear to grow out into long, grooved tusks, which arch over the upper jaw and prevent the animal from opening its mouth more than a few inches.

Sub-Order: *MYSTACOCETI.* WHALEBONE WHALES

The Whalebone Whales, whose distinction from the existing toothed whales has already been described, are divided at the present day into two well-marked families: the Right Whales[1] and the Rorquals.

[1] Called by whalers the "Right" whales because the other whalebone whales were wrong, that is to say, far less valuable, both for the whalebone and oil.



SOWERBY'S WHALE (*Mesoplodon bidens*).
Head and skull, showing single pair of teeth in lower jaw and remarkable frontal crest of bone.

FAMILY: *BALÆNIDÆ*. THE RIGHT WHALE

Balæna australis. THE SOUTHERN RIGHT WHALE

The hugest of the "Right" whales, commonly known as the Greenland whale (*Balæna mysticetus*), now so near extinction, and driven up to the most inaccessible parts of the Arctic Ocean, cannot be classed as a British mammal, because no certain evidence exists of it having been seen in close vicinity to the British Islands, the recorded instances of its presence being more probably referable (it is thought) to the species about to be described, the Southern Right Whale. But in the Pliocene deposits of Eastern England fossil remains are found (the ear bones) which would almost seem to indicate that the Greenland whale was found at one time in British waters.

The southern right whale does not grow to quite the same enormous size as the Greenland whale (which may be as much as 60 ft. long), and its head is also proportionately smaller. In the Greenland whale the shape and the size of the head are carried to the utmost degree of exaggeration. The southern right whale also is (or was, for it may be quite extinct by now) almost black in colour, and not marked with white in various parts of the body, as often occurs to the Greenland whale. Neither the southern nor the Greenland right whales have any dorsal fin, or any longitudinal furrows on the skin of the throat and chest. Its average length may not exceed 50 ft. The baleen, or whalebone, is shorter, and perhaps lighter in colour than in the case of the Greenland whale. This baleen is nothing but an extravagant development of the lamellæ or furrows of the palate (epithelium). These thin plates or blades of horny matter are broadest at their base where they are attached to the gum, and narrowest at their terminations. In their lowest portions they are frayed into a number of threads, and these threads serve as a fine sieve for the purpose of straining from the water the minute organisms on which the right whales feed. The plates of baleen may be as many as 380 in number. In the right whales they are generally black in colour, and gray or grayish-yellow in the other members

of the family. They are ranged transversely across the palate, exactly like the furrows in the epithelium.[1] In the right whales these plates are so long that, however widely the mouth is opened, they still close up the intervals between the jaws. The right whales open their mouths when they find themselves in the middle of shoals of minute crustaceans and pteropods,[2] and then close the mouth, forcing out the water through the sieve of the whalebone. The tiny organisms that are prevented from escaping by the fringe of the baleen plates then fall on to the broad tongue which lies in the great hollow of the under jaw, and in this manner are swallowed through the very narrow gullet. In the right whales the throat is so narrow at the swallow that it would probably allow nothing to pass of larger size than a mouse. When the mouth is shut the long fringes of whalebone fold backwards, the front plates lying below the hinder ones, so that in a sense the long ends of the whalebone are partially contained within the approach to the gullet. When the animal opens its mouth wide the whalebone springs forward till it is perpendicular.

Clione limacina. The little Pteropod Mollusc (bright purple in colour) on which the great Whalebone Whales feed (life size).

All the whalebone whales are considered to be characterised by possessing only four true fingers in the flipper, as against the five that are generally found in the toothed whales. There is a seeming exception to this in the right whales, where the hand appears to be five-fingered ; but it is the opinion of Mr. Beddard that the presumed first finger of the right whale is really the prepollex, the additional finger which occasionally appears in mammals before the first or thumb, and which no doubt in this whale has been retained or developed for the support of the

[1] These furrows exist even in the human palate.

[2] The principal source of the right whale's food is a pteropod mollusc about an inch long, named *Clione limacina*, bright purple when alive. Specimens of this little creature are exhibited in the admirably organised Whale Gallery at the British Museum (Natural History).

flipper. The finger which has disappeared drops out seemingly in the middle of the series, and is possibly the normal third finger. Whalebone whales, though such extreme types of cetacean development in many directions, yet retain a few primitive characteristics. The vestiges of hind limbs are more developed in right whales than in any other member of the order, for these small bones not only represent the pelvis and ischium, but also the thigh bone and a portion of the tibia or upper leg bone. All the whalebone whales, also, have double openings to the nostrils. They further have traces of a smelling organ, which is absent from other whales. It has been already stated that all the whalebone whales, when in the fœtal stage, have teeth in the upper and lower jaws, which in calcifying are absorbed by the time the animal is born. The whalebone does not commence to form till the young whale is several weeks old.

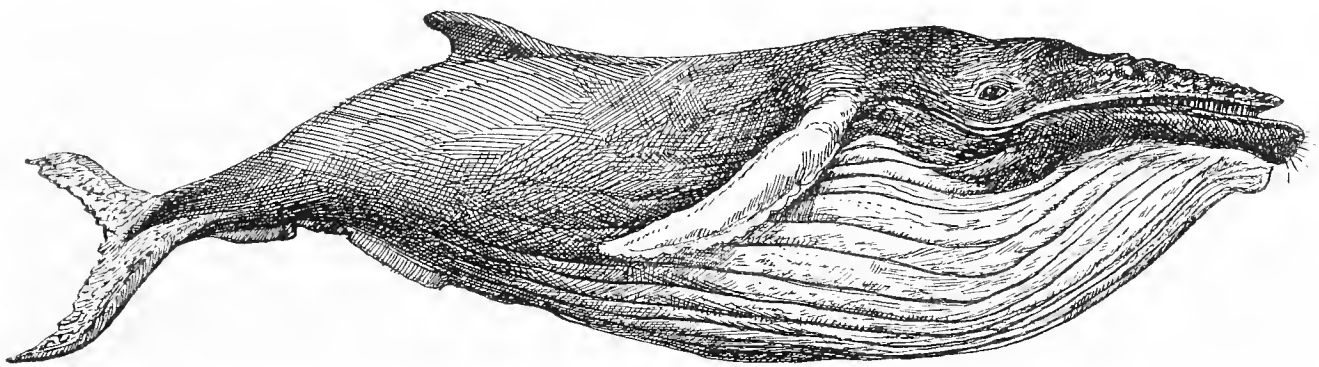
The southern right whale is now very nearly extinct. At one time it was certainly an inhabitant of the British Channel and of the North Sea, perhaps also of the Irish Sea and Atlantic coast of Ireland. It abounded in the Bay of Biscay, and was also found in the Mediterranean, and perhaps also on the east coast of North America, the South Atlantic, and the Indian Ocean. The last recorded certain appearance of the southern right whale in British waters was at Peterhead (east coast of Scotland) in 1806, though there is some evidence to show that a specimen was stranded at Yarmouth in 1846. Another was seen off Peterhead in 1872, while the bony remains of a right whale were dredged up off Lyme Regis in 1853.

FAMILY: *BALÆNOPTERIDÆ*. THE RORQUALS

These whalebone whales are not so much specialised as the right whales. The head is proportionately smaller, and the whalebone is much shorter.

Megaptera boops. THE HUMP-BACKED WHALE

In this whale the flippers are very long and narrow (with only four fingers). The vertebræ of the neck are free, and not



HUMP-BACKED WHALE (*Megaptera boops*).

fused. The eye is proportionately rather large, and is situated well above the angle of the jaw. There is absolutely no trace of a neck, and the body is even more fish-like in shape than that of any other whale. There is a back fin. A row of bony tubercles, referred to in connection with other whales, often grows along the edge of the lips. The skin under the lower jaw, and along the throat and a portion of the belly, is streaked with folds, which are so marked a characteristic of the Rorquals and of the Ziphioid whales.[1] There is a slight hump in the middle of the back. The head is often studded with large scaly tubercles about the size of an orange, which may also be the remains of the original bony plates that covered the bodies of the primeval whales. In colour the hump-backed whale is black above, with entirely white or black-speckled flippers, and with under parts marbled in black and white. The hump-backed whale is of almost universal distribution. As regards its connection with the British Islands, it is commonly seen during the summer off the east coast of Scotland and the north-east and north-west of England, occasionally appearing in large numbers off the north of Ireland. This whale frequently produces two young at a birth. The hump-backed whale eats much larger molluscs and crustaceans than the right whales, and it will also swallow small fish.

Balænoptera musculus. The Common Rorqual

This genus in the species next to be mentioned probably includes the largest of living whales. The Common Rorqual may be taken as a type of the genus. Curiously enough, in the rorquals, as also in the hump-backed whales, the female is generally bigger than the male. The length of the common

[1] These *plicæ*, or longitudinal folds, are thought by some whalers and zoologists to serve almost the purpose of gill openings in fishes, and to oxygenate the blood from the oxygen of the water by dermal respiration. The Balænopterids are certainly able to remain for very lengthened periods—twelve hours, it is said—beneath the surface of the water without coming up to breathe atmospheric air.

rorqual is not known to exceed 70 ft. The head is proportionately smaller to the body than in the right whales or in most of the other rorquals. It has also some slight indication of a neck. It is the species which I have chosen to illustrate in a coloured drawing, which is partly based on the painting of a rorqual cast up on the east coast of Ireland in 1860. From this painting it will be seen that in colour this whale is blackish-gray above and white beneath, though the white is often modified by gray and yellow tinges. The whalebone is yellowish gray, sometimes whitish in parts, or touched with brown or slate-gray. The interior of the numerous folds on the under surface of the body is black.[1] There is a low back fin placed very far down the body not far from the tail.

The common rorqual is less restricted in its choice of food than the other whalebone whales. It can swallow herrings and even larger fish as well as molluscs and crustaceans. This whale is no rarity in British waters. It is widely distributed over both the Atlantic Ocean and the Mediterranean. It is more frequently met with in the English and Irish Channels than in the North Sea, but specimens are cast up frequently year after year on the coasts of Ireland, Wales, and England. In Scotland it is met with in the vicinity of the Orkney and Shetland Islands, and occasionally in the Firth of Forth. It produces such inferior baleen and blubber as to be scarcely worth killing for commercial purposes. This, perhaps, is the reason why it still exists in considerable numbers.

Balænoptera sibbaldii. Sibbald's Rorqual, or the "Blue" Whale

This is the largest of all known whales. Specimens have been credibly recorded that measured 90 ft., though an estimate of 105 ft. has sometimes been quoted. Several specimens have been measured which were 80 ft. in length. A pregnant female which was cast up near Edinburgh in the Firth of Forth contained

[1] Sometimes in the living animal rosy-red.

within it a male fœtus which measured nearly 20 ft. in length. In this species the head is much larger proportionately than in the common rorqual, while the flippers are longer and broader. There are also a great many more folds in the throat and belly. The dorsal fin near the tail is reduced to little more than a slight protuberance. The colour of the baleen is deep black, thereby contrasting strongly with the yellowish-gray of the common rorqual's whalebone. The colour of the body is dark gray above, shading into lighter gray on the belly. The gray of this whale is often quite bluish in tone, for which reason it is known amongst whalers as the "blue" whale. Its gray coloration is also varied by small whitish spots on the breast. The upper side of the flippers is black and the under whitish. Off the east coast of America the under parts of this whale have frequently a lemon-yellow tinge. The "blue" whale feeds principally on small pteropods and crustaceans, such as *Clione*, *Euphausia*, and *Thrysanopoda*. It also eats small fish, such as sardines and sprats. This whale seems to be distributed throughout the greater part of the Atlantic, Pacific, and Indian Oceans, unless in the last-named sea its representative is a different species or variety. It is fairly abundant in the North Sea, being much attracted to the coasts of Norway, because of the presence in the fiords of the crustaceans on which it lives. Its occurrence in British waters is a much rarer event than is the case with the common rorqual, but it has been washed ashore at various points of the Scottish coast, in the Hebrides, and on the north-east coast of England. Sibbald's whale yields much more oil proportionately than does the common rorqual.

Balænoptera borealis. Rudolphi's Rorqual

This whale scarcely reaches to 50 ft. in length. Its flippers are very short proportionately. The whalebone is black, except at the extremities, where it turns white. The upper parts of this whale's body are bluish-black, marked with oblong spots of light gray; the under parts of the body are whitish-gray. The upper surface of the flippers is entirely black. The throat is streaked

with the same longitudinal folds as in other rorquals. The back fin is unimportant, and only just discernible as a slight excrescence. Rudolphi's Rorqual inhabits the Atlantic, the North Sea, and the British Channel. It is also thought that it or a closely allied form is found in the Indian Ocean. Its discovery as a member of the British fauna seems to date no further back than 1872, when one was stranded on the shores of the Firth of Forth. Subsequently Rudolphi's rorqual was found repeatedly on the east and south-east coasts of England. A fine example actually entered the Thames, and was captured at Tilbury in 1887. Another entered the Medway, and was stranded near Rochester in 1888. This one was said to utter sounds like the crying of a child when it found itself hopelessly stranded. It is stated that Rudolphi's whale feeds exclusively on small crustaceans and never touches fish, but this is doubtful in view of the fact that the one which entered the Thames in 1887 did so in pursuit of a shoal of sprats.

Balænoptera acuto-rostrata. The Lesser Rorqual, or Pike Whale

This whale is quite commonly captured or stranded on the coasts of England, Scotland, and Ireland. The female is said to seek the vicinity of the coast when about to bring forth her young. The Lesser Rorqual is the smallest of all this family of whales. It scarcely exceeds 30 ft. in length, and is usually smaller. The colour of the upper parts is blackish-gray, rather sharply distinguished from the white of the throat and belly. There is a white band across the flipper. The long creases or folds which mark the throat and a portion of the stomach are often orange-coloured, and sometimes black in the inner part of the fold. The baleen is yellowish-white. The dorsal fin is placed higher up in the body than in other rorquals, and is longer.

This whale is of relatively common occurrence along the British coasts. Elsewhere it is found in the North Sea, and as far north as the Arctic Ocean, and over the whole of the North

Atlantic. A closely allied form is found in the North Pacific; which, indeed, may be identical. The lesser rorqual also feeds on small crustaceans and tiny fish.

The remains of fossil whales related to the rorquals, as well as others closely allied to the right whales, are found in some abundance in the Eocene formations of East Anglia; perhaps also of Hampshire, in which county remains of the archaic Zeuglodonts (*Archæoceti*) have been discovered. From these remains in England and Belgium, it would almost seem as though the North Sea at one time was a great area of development and radiation for the *Mystacoceti*, or whalebone whales, if not, indeed, for the whales generally.

CHAPTER IV

ORDER: *INSECTIVORA.* INSECT-EATING MAMMALS

THIS is an order to which, as Huxley said, it is exceedingly difficult to give a definition. They are none of them large animals, and appear always to have been small throughout their long history. They are of the highest interest to the biologist because they are almost as remarkable in possessing archaic features as the Monotremes and certain Marsupial types. The Insectivores of to-day offer in some of their forms very nearly exact reproductions of the earlier placental mammals which existed at the close of the Secondary Epoch. There are some points, indeed, in which the Insectivora are of lower development than the modern Marsupials, several of their existing types being practically Monotremes, like the ornithorhynchus of Australia—that is to say, having only one shallow cloaca in the female, which receives and exudes the excreta of the bowels, kidneys, and ovaries. Others, again, in the number of their incisor teeth, the inflection of the lower jaw, and the construction of the palate, resemble Marsupials. The Insectivores usually possess clavicles (collar bones), which are absent in so many specialised mammals. Their limbs usually retain the five toes. They are, with one or two rare exceptions, plantigrade—that is to say, when they walk they place the whole of the hand and foot on the ground, as do monkeys and bears, not walking only on the fingers or toes or on their nails. The nose is long, and often developed into a proboscis or snout. The mammæ, or teats, in the Insectivores tend to be very numerous—often as many as

seven pairs, and in one species of tenrec twelve pairs. Their teeth are remarkable in several ways; frequently presenting the typical and Eutherian number of forty-four.[1] The molars in the generalised types are of simple tritubercular construction; in the others they are many-cusped. The canines and incisor teeth are normally present in both jaws; and in regard to the incisors, several species of Shrews exhibit an apparent affinity to the Marsupials, and perhaps to the earlier Mammals, in that they have four pairs in the upper jaw instead of the normal three.[2] There is a third trochanter to the thigh bone, and an entepicondylar perforation of the arm bone (humerus, see p. 149). Both these are archaic features. The canines in some species are double-rooted—a peculiar and perhaps a primitive feature met with in that curious animal the flying cobego of Eastern Asia, which has affinities to the Bats, the Lemurs, and the Insectivores.

In their origin the Insectivores are with difficulty distinguished from the early types that gave rise to the Primates (Lemurs) or to the Carnivores. The order certainly dates from the Secondary Epoch, and one genus—*Erinaceus* (the Hedgehog)—is one of the oldest genera of existing mammals, for it has continued on the earth (in France, if not in England) in an unaltered form from the Miocene period of the Tertiary Epoch.

[1] In *Centetes*, a Madagascar genus, there would appear to be four pairs of true molars. This may also occur in other insectivorous forms. See p. 115.

[2] In several Marsupials there are even five incisors on either side of the upper jaw, and in a great many there are four. On the other hand, in the Theriodont reptiles it is doubtful whether there were more than three on each side. A proto-mammal with four incisors on each side of the upper jaw has been postulated to explain this feature in the Marsupials, and perhaps in the Shrews; but the more reasonable suggestion has been put forward latterly that in the Marsupials the fourth and fifth incisor on each side may be only an instance of the first, or "milk," dentition remaining persistent. Either this may be the explanation of the four incisor teeth on each side of the upper jaw in the Shrews, or the extra incisor may be a canine, and the supposed canine a premolar.

Photo by C. Reid.

HEDGEHOG ROLLED UP.

Photo by C. Reid.

COMMON HEDGEHOG (*Erinaceus europæus*).

To face p. 54.

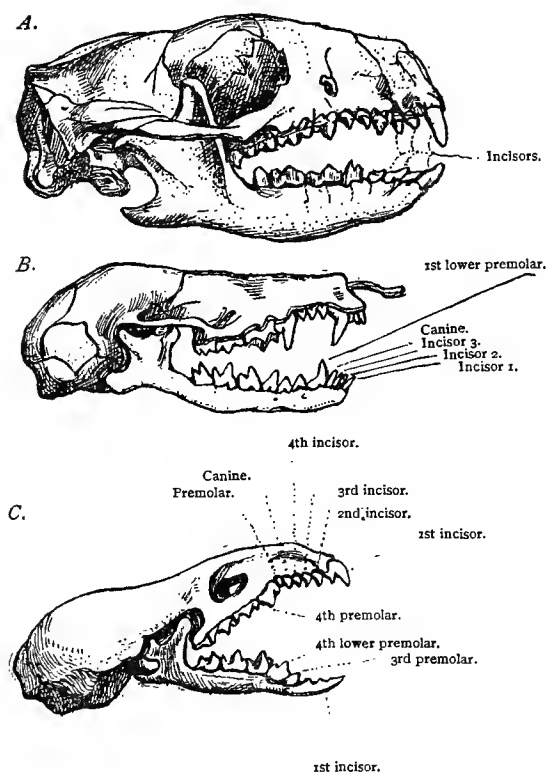
FAMILY: *ERINACEIDÆ.* THE HEDGEHOGS

Erinaceus europæus. THE COMMON HEDGEHOG

The Hedgehog found in Britain shares with other members of the genus *Erinaceus* the striking outward characteristic of hair developed into sharp spines, which extend in a thick growth all over the upper surface of the body from forehead to the rump. The cheeks, throat, belly, and limbs are covered with coarse hair. The hedgehog is coloured as follows in most adult specimens:— The forehead, the short ears, the throat, chest, and all the under parts except the limbs are yellowish-white or pale buff. The snout and muzzle are blackish-gray. At a distance the spines are coloured a warm brown shot with white and black, the spines being grayish-white at the tips, but brownish-black or black and brown in the middle of their length. The length of head and body is about ten inches, and the tail is another inch and a half. The tail is naked above and hairy on the under surface. The ear conches are broad and round. They are quite short, and are partially hidden by the coarse hair of the forehead. The claws are long and grooved, but weak. The muzzle ends in a snout-like nose. The legs are so short that the creature almost touches the ground with its belly as it walks. The pig-like snout, short neck, long body, and bristles are so suggestive of a miniature hog that the common English name is a very apt one.

The hedgehog's peculiarity of teeth should be noted, as it is of interest in several ways. There are three pairs of incisors, one pair of canines, three pairs of premolars, and three of molars in the upper jaw; in the lower jaw the incisors are reduced to two pairs and the premolars to two pairs also. The inner pair of incisors in the upper jaw are very long and tusk-like, and are separated from one another by a short interval. The companion pair of inner incisors in the lower jaw are also long, and are proclivous, that is to say, placed in a horizontal position. The exceptional size of these teeth and their position quite suggest a foreshadowing of the way in which the Rodents may have developed from a low type of Eutherian mammal allied (as

was probably the case) to the Insectivores. In fact, if the hedgehog could have been traced back to a period as remote as the end of the Secondary Epoch it might not have seemed unreasonable to consider it as the first departure from the generalised Eutheria in the direction of the Rodents. The second and third incisor teeth in the upper jaw of the hedgehog are becoming a negligible quantity, and in some of the Asiatic species the second incisor almost disappears. The upper and lower canine teeth are not markedly prominent. In some of the Asiatic species the upper canines and the third incisors are inserted by a double instead of a single root. But in the British hedgehog (*Erinaceus europæus*) these teeth have only a single root, though in the canines there is a groove that suggests that the root was originally double-fanged. The third upper premolar in the series (it should properly be styled the fourth, an intermediate one having dropped out) is also a notable tooth, with a trenchant blade, resembling the great carnassial fourth premolar so characteristic of the true Carnivora.



SKULLS OF INSECTIVORES, TO SHOW TEETH.
A. Hedgehog and *B*. Mole (nat. size); *C*. Lesser Shrew (2½ times nat. size).

The hedgehog has five pairs of teats, and the number of

young born at a time varies from four to six. The young are born blind, and nearly naked, the sprouting spines being white in colour, and quite flexible. Nor are they at this tender age able to roll themselves up, which habit would be of little use to them then, since the undeveloped spines would offer no protection. Breeding between hedgehogs takes place in May or June, and the young are born after only a month's gestation. Sometimes a second litter is produced in October.

The use of the spines as a protection is seen at once when the hedgehog, on the approach of anything which is likely to be an enemy, rolls itself up into a prickly ball. The head and all four limbs are tucked into the soft belly, and the creature becomes almost a ball in shape. It is doubtful if it would have lingered as a common animal in Europe for several million years had it not very early in its history developed this protective coat. Practically no enemy but man can kill it with certainty under ordinary conditions. It is said, however, that the long and strong claws of the badger serve sometimes to tear open the rolled-up hedgehog, which is then attacked from its hairy belly and eviscerated. The fox is also said to be able, by various clever dodges, to injure the hedgehog and cause it to open, such as, for instance, pushing it or rolling it towards the edge of a bank, and thus letting it fall from a height so that the shock bruises the spines, or stuns the hedgehog, and causes it to relax.

During the winter—generally commencing in December—the hedgehog goes into retirement under a mass of dead leaves, or in some cranny lined with moss. Here, tightly rolled up into a ball, it becomes absolutely torpid, and sleeps till the first warm day in March. During this period it is not known to eat, and, unlike other hibernating animals, lays up no store of food.

The habits of the hedgehog are mainly nocturnal, though occasionally they are seen moving about in the daytime. None of the Insectivora (another sign of lowly development) possess a loud or varied voice. The hedgehog is a silent animal, but can apparently squeal and cry when caught in a trap. Ordinarily, it

utters a hoarse squeak either when pursuing its mates or its prey. The food of the hedgehog is, in the first place, nearly every insect it can get hold of, together with slugs, snails, spiders, and worms. It also kills and eats frogs, snakes (innocuous and viperine), small birds, and no doubt besides mice and moles, young rabbits and hares. Of eggs it is very fond. Hedgehogs in captivity will also eat cooked vegetables, and they are very partial to milk.[1] Earthworms are eaten slowly, and are chewed to death—that is to say, crushed between the long blades of the big premolar teeth. Being so extremely undiscriminating in its insect diet, the hedgehog can render the greatest services to a house which may be infested with crickets and cockroaches. It is one of the few vertebrates which will willingly eat a cockroach, a diet which is most unwholesome for cats, and singularly repellent.

Its method of attacking adders is (according to Mr. J. E. Harting) cautious and intelligent. Dodging the first angry movement of the viper, the hedgehog dashes in and endeavours to inflict a bite on the back. After the snap, it instantly ducks the head and rolls into a ball. Unless the viper is disabled by the first bite it strikes at the hedgehog's spines, of course quite ineffectually as regards piercing its skin. The viper, indeed, may strike and strike again till it injures and incapacitates itself on these sharp-pointed spikes. Whenever the hedgehog thinks it can dodge the viper's darts, or when that creature has exhausted itself by vain attacks, the hedgehog repeats its sharp bites at the backbone till the snake's spine is broken. As soon as the viper is thus thoroughly disabled, the hedgehog passes the body gradually

[1] There is an old-established tradition, not only in England, but in other countries, that hedgehogs will suck milk from the udders of cows which are left out in the fields at night. This story is alternately revived and scouted. It does not, however, seem by any means improbable. The hedgehog would probably seek the recumbent body of the cow to feed upon the insects which might be settled on the cow's skin. It is a well-known fact that when cows or even bitches and other female mammals are in full lactation, drops of milk will ooze out of the nipple. The hedgehog would naturally at first be attracted to this oozing milk, and might from that proceed to suck at the nipple.

through its jaws, cracking the bones with its molars and premolars at short intervals till the whole body is limp. He is said then to begin at the tip of the tail and eat the snake gradually from that direction.

Hedgehogs, we have all heard or read, were formerly eaten by the agricultural labourer, and more certainly by the gipsies. The latter, after killing them, roll them in clay and bake them. When a sufficient time has elapsed the clay ball is broken open, and the spines embedded in the clay are torn out, leaving the flesh of the hedgehog cooked and accessible. The animal has, however, a filthy flavour, derived, with its smell, no doubt, from some of those preputial glands possessed by so many of the Insectivora.

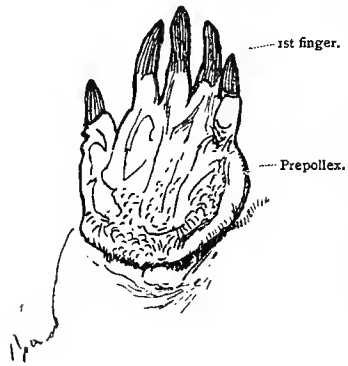
The distribution of the hedgehog in the British Islands is as follows :—It is found pretty nearly all over England, except, of course, in the vicinity of towns. In Scotland its range was formerly limited to the south and centre, but now it is creeping northwards. It is, however, absent from the Hebrides and all the larger islands off the west coast of Scotland. It is found in the Orkneys and Shetlands, but some authorities think its presence there is due to human introduction. In Ireland its distribution is somewhat interrupted, but it would appear to be indigenous to that island. Outside the United Kingdom the common or European hedgehog extends its range through Central Europe, across Asia to the Chinese coast of the Pacific Ocean. It is also found in Syria, Asia Minor, and Italy.

FAMILY: *TALPIDÆ.* THE MOLES

The Moles, like the hedgehogs, seem to have originated in Europe, or at any rate in the temperate regions of the Old World. Some genera of moles, however, are found in North America. The moles are distantly allied to the shrews, than which, however, they are less specialised in dentition. In all of them the eyes are very small, and in some practically functionless. The outer ear is short, and completely concealed by the fur. This group is represented in the British Islands by

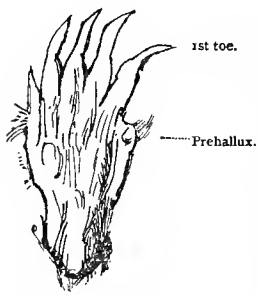
Talpa europæa. The Common Mole

This animal is about 6¾ in. long, and of this length the thick bristly tail occupies nearly 1½ in. The body is almost cylindrical, and there is no clearly defined neck. The front limbs are remarkably modified. The elbow of a mole's arm is contained within the body, and the arm only protrudes from the wrist joint. This and the lower part of the arm are deflected in such a way that the palm of the hand is turned outwards and sideways. The bones of the hand are remarkably expanded, and on the inner or "thumb" side there is a flattened bone that might well be the prepollex,[1] which looks, in fact, like a false thumb. The upper arm bone, or humerus, is extraordinarily curved and shortened.



Hand of Mole.

The eyes in the Common Mole are not, as is often supposed, absolutely non-existent. It is thought, nevertheless, by the most recent authority on the subject, Mr. Lionel E. Adams[2] (quoting also from Saint Hilaire and Mr. Trevor-Battye) that an adult mole is practically blind. Saint Hilaire, however, thought it was extremely short-sighted. There is no doubt that when the extremely minute eye of the mole is exposed it has



Right Foot of Mole.

[1] It is a moot point whether the first air-breathing vertebrate, which grew by degrees from out of a fish into an amphibian and was the parent form of all land vertebrates, was six-fingered or five-fingered. There is a constantly recurring tendency, throughout mammals (at any rate), for a sixth finger to make its appearance, preceding the thumb. This is termed the prepollex.

[2] *A Contribution to our Knowledge of the Mole* (Manchester Literary and Philosophical Society, 1902).

some power of vision, and is at any rate sensitive to light. What is remarkable is, according to observations made by several persons, including the present writer, that, although under normal circumstances the eye is rendered quite invisible by being completely covered with hair, the mole can at will cause this fine fur round the eye to radiate, thus leaving the eye exposed. In the accompanying picture I have painted a mole with the eye thus exposed to sight. The eye of the young mole is more developed, and larger in the fœtus and in the newly-born young.

The mole has four pairs of mammæ, or teats. There is a curious point about the external genitalia of the mole which requires some notice and explanation. As in the spotted hyæna and one or two other mammals, the outward appearance of males and females is absolutely similar to a superficial observer—that is to say, all moles appear to be males. In these Insectivores, as in a good many forms of this group, the testes are abdominal, and the long clitoris of the female exactly simulates the male preputium. It is only during the short breeding season that any difference in the sexes can be determined.[1]

There are no external ears in the mole. The fur is plush-like in appearance. The individual hairs are very fine and silky. They are short, and are set vertically in the skin, and do not lie in a sloping direction. Their arrangement, therefore, is exactly like the silk threads in velvet.

As regards colour, the under part of the mole's fur is generally a rich dark brown, but the effect on the surface of the body is more or less black, or dark bluish-gray. The females, especially on the face and belly, are generally a little browner than the male. There is a marked tendency, however, amongst the British moles towards variation. In them, as in one or two foreign species, an orange patch sometimes appears on the chest. More common variations are an olive tint, a pale

[1] Very full particulars are given on this point, with anatomical drawings, in Mr. L. E. Adams's article on the Mole (Manchester Literary and Philosophical Society, 1902).

gray, a cream colour, an orange or piebald. White moles are sometimes met with; while a white mole with a reddish-brown throat, and a black mole with a white head, have also been recorded.

The teeth of the mole are less specialised than its front limbs. They are the primitive forty-four in number, and consist normally of three incisors, one canine, four premolars, and three molars on each side of each jaw. In the adult mole, however, one of the upper premolars (the first) is frequently missing, so that the adult dentition is sometimes reduced to forty teeth. There is also a tendency among moles, especially species allied to the European moles, to lose the lower canine, which has become an unimportant tooth exactly similar to the incisors in appearance. The first lower premolar is tusk-like, and replaces the lower canine in its functions. The lower and upper incisors are small and chisel-shaped, and never assume the long tusk-like form of the incisors in the hedgehogs and shrews. The upper canine is two-rooted, with a heel, trenchant, tusk-like, and much more important than in the hedgehogs and the shrews.

The nose of the mole is long,[1] and terminates in a blunt snout,[2] in which the nostrils are situated, placed close together. The upper lip (the opening of the mouth is some distance behind the termination of the snout) is cleft by a median line.

The breeding-time of moles is confined to a short season in the spring, generally in the month of April, though they may begin to breed in March, or the breeding may continue till the beginning of May. The period of gestation is about five weeks.[3] The young, which are never less than two and are not known to be more than seven in number (generally there are four in a litter), are born quite naked, but at the age of five weeks they

[1] The mole is extremely sensitive on the snout, and can be killed by a relatively slight tap on that part of the head.

[2] This snout, which plays a most important part in the burrowing of the moles, is supported by a strong cartilage, which ossifies into a bone a quarter of an inch long.

[3] Some authorities say four and some six weeks, but five weeks seems to be the average time.

are able to move about on their own account, and are then three-quarters grown. They are able to breed at the age of ten or eleven months. It is now made quite certain from the investigations of Mr. Lionel E. Adams that the mole only breeds once in the twelve months. The same writer and other recent authorities have shown that the former supposition regarding the great excess of males over females is also incorrect, and is due to the anatomical peculiarities referred to in connection with the genital organs. Males and females are about equal in numbers. The males are not exactly polygamous, but a male mole during the breeding season will pay attentions to as many females as will permit of his approaches, and one female mole will often be surrounded by a number of males, who may engage in fierce fights to secure her. When the female is nearing the end of her pregnancy she retires from the males' society, and makes a separate fortress and nest in which to bring forth her young.

The mole is described as being extremely voracious. This is perhaps because it is unable when adult to go for any period more than a few hours without food; in fact, it easily dies of starvation. Besides worms, which form its principal diet, and the pursuit of which through the soil has done so much through ages to shape the mole into what it is now, this creature eats almost any insect it can capture, and consumes no end of grubs and larvæ. It also eats slugs and snails, frogs, lizards, small birds, or the young of its own kind. Specimens in captivity have been known to consume and apparently to digest in the course of twenty-four hours a mass of food equalling their own bodies in weight. The mole is also a very thirsty animal, and its fortresses are never placed very far from water. On the other hand, the mole itself falls a victim, not only to the indignant gardener or the callous gamekeeper,[1] but to weasels, stoats, foxes, badgers, owls, buzzards, and herons. Hedgehogs are quite willing to eat them, but cannot do so as a rule, because their weak claws and incisor teeth are not sufficiently sharp to tear open the tough skin

[1] Who accuses it of robbing the nests of pheasants and partridges and eating their eggs.

of the mole. But it is probably not a favourite article of diet with any of these carnivorous creatures, because its dark flesh has a sickening musky smell and taste.

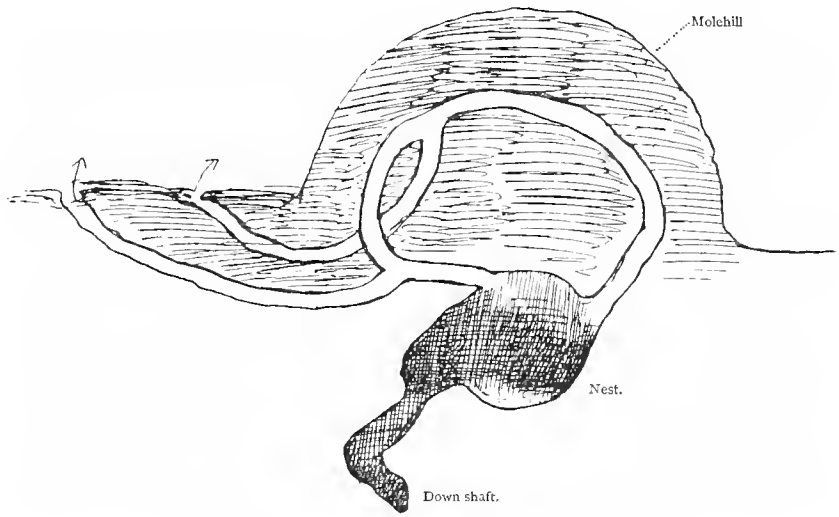
Moles do not hibernate : they remain quite active during the winter, even throwing up molehills through the snow where the latter does not lie deeply. If the ground is frozen hard the mole has to confine his journeys in search of food (worms) to below the surface. It is of course mainly nocturnal in its habits so far as emergence from its subterranean home is concerned. I have, however, seen moles not infrequently in broad daylight in the summer-time.[1] When they are aware that they are being watched (no doubt from their senses of smell and hearing) they attempt to escape by scuttling over the ground, moving their large hands alternately. Their fastest pace on a smooth surface above ground is only equal to a man's slow walk.

The mole is able to swim. This it does with the whole head and a good deal of the body and even the tip of the tail above the water. It makes great way with its huge flat hands, which beat the water downwards and backwards.

To remain secure from its enemies and at the same time to obtain supplies of its favourite food (worms), the mole excavates cavities in the ground which are called its "fortress," and in these the nest is constructed, the "fortress" being reached by at least two tunnels. The site of the fortress is generally chosen at the side of a bank or beneath the roots of a tree-trunk, or more often in an open field or turfy downland. A circular cavity is first of all scooped out by the front paws, and the loose soil is then pushed out and up on to the surface, the pushing being done by the nose and the top of the head. All this soil which is excavated to form the hollow or hollows (for there are sometimes two or more nests, one above the other) forms the molehill. This dome (the earth of which is rendered strong and solid by being constantly pressed and beaten by the mole when it

[1] A place where moles for some reason are remarkably *en évidence* during the daytime is that sandy gorse- and heather-covered promontory of Hengistbury Head, near Christchurch, Hampshire.

is being formed) is permeated above the globular inner cavity by a series of galleries, some of which are blind alleys, while others open out into the air, generally below the outer surface of the molehill, but sometimes at points in the sides of the dome itself. The main entrance, the high road, so to speak, into the fortress has a circumference larger than the body of the mole, though not large enough to permit of two moles passing each other. Indeed, should an intruder meet the owner of the domain, the two moles must either fight for mastery, or one of them must back into



PLAN OF THE INTERIOR OF AN ORDINARY MOLEHILL.

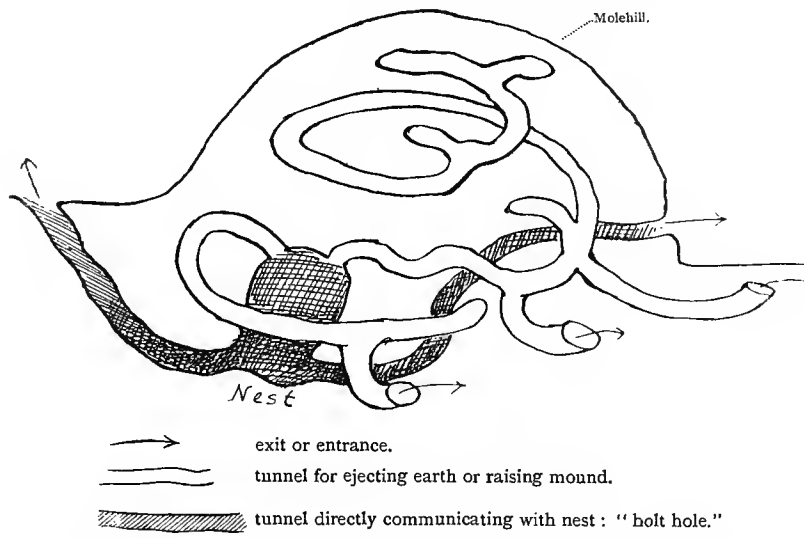
a side alley and give way. This long tunnel is widened and heightened more by the constant passage of the mole's body than by excavation. The mole, so to speak, forces his way through the yielding soil, and by the compression of the earth makes the sides of the passage smooth and compact. This high road extends right through the mole's domain, and opens to the surface at a considerable distance from the fortress. It is paralleled on the other side of the nest by another passage, much shorter, however, generally called the "bolt run," which is, in fact, a short exit from the fortress to the upper surface of the

ground. From above this nest cavity start several or many tunnels into the mound, called the molehill, which is formed by the excavation of the nest. These, it is supposed, are used for ejecting earth from the nest cavity. They are, however, often spiral in their ascent from the nest, with many branches, most of which may end blindly without emergence into the open air.

In a complicated fortress the design of which is given by Mr. Adams there are as many as eleven exits from the branches of these spiral tunnels into the open air round the base of the molehill. Mr. Adams considers that these often very elaborate galleries are simply formed in the process of ejecting the mould from the nest cavity, and are not to be considered as elaborate labyrinths along which the mole may evade rivals or other enemies. Much cleverness is displayed by the moles in excavating their fortresses in marshy land or by the banks of streams. A way of escape is always arranged above flood level, which the mole by some inherited instinct or experience seems to be able to gauge pretty correctly. The curious down shafts, ending blindly, which are found in some moles' nests, were thought at one time to be receptacles for paralysed worms which the mole was storing up for food, or a provision for draining the nest in the case of wet weather, or wells which should provide the mole with underground drinking water. All these theories are derided by Mr. Adams, who believes that these down shafts are little else than projected bolt holes which have been abandoned when half made. The bolt hole, or alternative main exit from the nest, is generally started in a downward direction and then turns up somewhat abruptly towards the surface. Sometimes these abandoned pits below the nest do contain bunches of sickly looking worms, but these have probably fallen in accidentally. The nest itself, which completely fills the nest cavity, is a ball of grass or leaves, or a mixture of both. There is no hole or entrance to this spherical structure of dried vegetation. When the mole quits it, it manages in some way to arrange the stems of grass or leaves so as not to suggest a passage. Mr. Adams relates that in his experience the inside of the nest is warm to the

touch long after the mole has left it, and that when there are young in the nest it is infested with fleas and mites.

The fortress of the mole, in spite of this elaborate construction, is not necessarily a permanent residence. It is inhabited from September (say) to June.[1] During the summer months the mole lives in it little if at all. He spends a good deal of his time at night above the surface of the ground seeking for prey in that direction, and during the day he may be traversing the loose soil



PLAN OF A MORE ELABORATE MOLE "FORTRESS" (after Mr. Lionel E. Adams).

(only an inch or so under the surface) in long "mole runs," seeking for worms. The nest of the female who is about to give birth to young is usually constructed on a more simple plan than the fortress of the male, and seldom possesses a second exit or bolt run. It would seem that male and female prior to the breeding season do not share the same fortress. Except for brief meetings during the courtship, the sexes in adult individuals live apart. The long straight runs are considered to be those

[1] The mole, no doubt, often returns in September to the fortress it used before the summer, but in this case sometimes makes a fresh nest above the old one.

constructed by the males, whilst the winding tunnels are made by the female. In the bringing up of these tunnels to the surface the masses of earth that are propelled by the mole's forehead and snout often come out solid like a sausage. In lighter soil the mould is propelled upwards in little jerks. Mr. Adams expresses the wonderment that must have been felt by many observers of the mole at the way in which runs are made through such hard ground as sandstone, ground that the spade penetrates with the greatest difficulty, but through which the mole makes long runs, and turns out heaps of stones, severally weighing as much as 4 oz., the maximum weight of the mole itself. In this hard formation the runs lie as much as a foot beneath the surface, and they are also very wide. In soft soils the runs may be so near to the surface that it not infrequently becomes a mere trough, and the back of the mole may be seen as it passes along.

The distribution of the mole in our country is signalised, as in the case with so many other mammals, by its complete absence from Ireland. It is found almost universally throughout England and Wales, even to the westernmost extremities of the last-named country. In Scotland its distribution was formerly (in the eighteenth century) confined mainly to the lowlands, but during the last hundred years it has been making its way steadily into the far north and west of that country, reaching even (through the accidental intervention of man) into the large islands close to the West Highland coast. It is evidently an instance of a British mammal slowly advancing northwards and westwards after the recovery of these islands from the last Glacial episode. In England, especially in East Anglia, the mole is an ancient inhabitant, its fossil remains dating from at least as far back as the end of the Pliocene period of the Tertiary Epoch. It thus dwelt in South Britain before the advent of man, and before the commencement of the first cold period. The mole as a genus stretches back to a great age in the geological past, our English species on the Continent being found in deposits of the Lower Miocene, while moles a little less differentiated in type go back to the earliest

period of the Tertiary Epoch. The present distribution of *Talpa europæa*, besides England and Scotland, extends at the present day over the greater part of Central Europe and Asia. It is found in Japan and in the Himalaya and Siberian mountains.

FAMILY: *SORICIDÆ*. THE SHREWS

The Shrews are Insectivores of small size and mouse-like appearance. Some members of this family (but not the British species) are remarkable for possessing an archaic feature suggestive of the earliest types of the Mammalia. Instead of there being three external and unconnected orifices in the female (the anus, urinary meatus, and vagina) for the separate excretion of the contents of the intestinal canal, the urethra, and the womb, there is but one; these passages opening into a common cloaca, or vestibule, which, though shallow, is still a single orifice externally for these three canals. This is the condition met with in the *Monotremata* (such as the duckbill of Australia), which for this reason are separated from the rest of the Mammalia into a sub-class. In another respect the shrews are thought to be archaic, in that they possess four incisors on each side of the upper jaw, a condition similar to what obtains in so many marsupials. This point, however, is not quite certain, as the fourth incisor may prove to be a canine, and the so-called canine a premolar.

The family of Shrews contains the smallest known mammal, *Sorex suaveolens*. The next smallest in size is the British species, *Sorex minutus*.

GENUS: *SOREX*. THE TRUE SHREWS

In these little animals, two representatives of which are found in Britain, the openings of the female generative and urinary organs are separated from the anal orifices. The teeth are coloured red at their extremities, and offer noteworthy features. The first incisor in the upper jaw is developed into a large two-pronged hook. The second and third incisors, the tooth which is taken to be the fourth incisor, and the canine

are all small teeth of uniform size and appearance in the upper jaw. Next to the supposed canine there is a minute premolar, almost undistinguishable in the common shrew, but larger and more evenly placed in other shrews. The second of the two upper premolars—probably the fourth of the normal series—is larger than the molars, as in the hedgehog. In the lower jaw of the shrews there are only two incisor teeth on each side. The first of these is a very long, procumbent tusk, markedly serrated on its upper surface with two or three hook-like processes. The second lower incisor is unimportant; there is no canine, and there is only one premolar. The teeth of the shrew even more than those of the hedgehog suggest a very close analogy of the way in which the specialised dentition of the Rodents arose.

In the shrews the ear conches are better developed than in the moles or in the water shrew. The snout of the shrews is produced into a long, almost proboscis-like nose, from the sides of which radiate a large number of vibrissæ—those fine or coarse bristles which are developed on the faces of so many mammals, and which are the origin of the moustache in the human. The skull of the shrew is strikingly different from that of other Insectivores by the almost complete absence of the zygomatic arch, or "cheek bone."

Shrews do not burrow beneath the soil, but dart in and out of the herbage, sometimes forming clearly marked runs round the base of trees or round the stout stems of herbaceous plants.

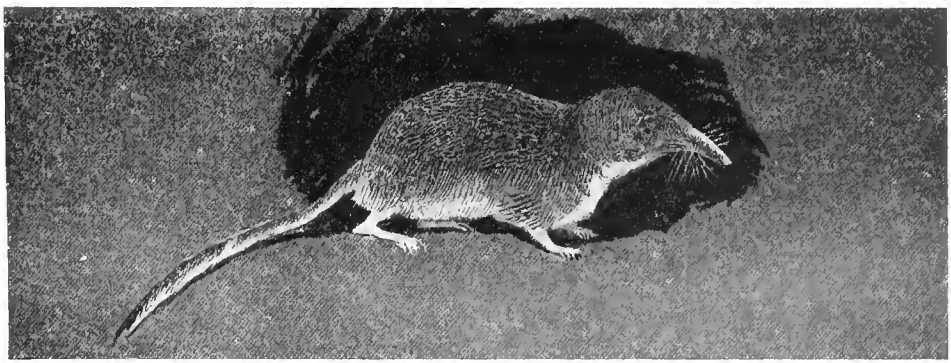
There are three pairs of mammæ in the shrew. The breeding season is apparently limited to the spring, at which time the female gives birth to from five to seven young.

Sorex vulgaris. The Common Shrew

This animal is about $2\frac{3}{4}$ in. long from the snout to the base of the tail, and the tail, which is tapering and covered with short hair to the tip, is another $1\frac{1}{2}$ in. in length. The Common Shrew is a reddish-gray in colour, the under parts being gray or pale buff. Sometimes the fur is flecked with white. Exceptional

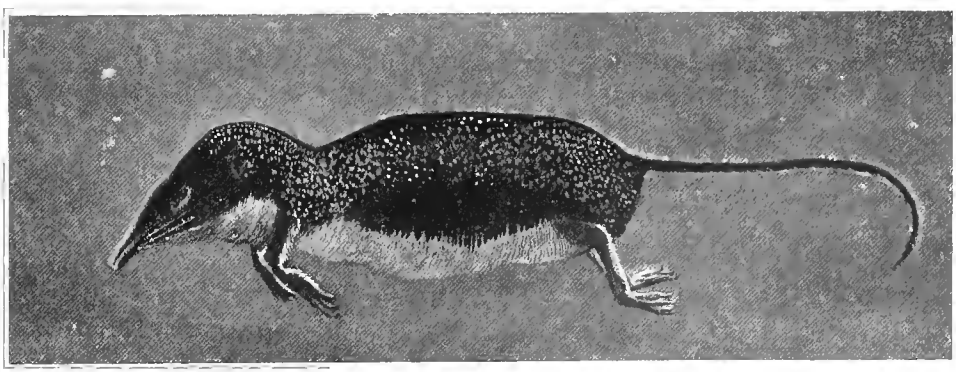
Photo by T. A. Metcalfe.

COMMON SHREW (*Sorex vulgaris*).



From a drawing by the Author.

THE LESSER SHREW (*Sorex minutus*).



From a drawing by the Author.

THE WATER SHREW (*Crossopus fodiens*) UNDER WATER.

To face p. 70.

forms have been met with in England with a white band over the loins, or boldly pied in other ways with white patches. Although the normal colour of the upper parts is a reddish-gray, this tint strengthens into chestnut in some examples, or deepens into black. The external rim or conch of the ear is small and rounded, but is quite discernible. On the flanks on either side there is a gland covered by rows or patches of hairs much coarser than the rest of the coat. These glands secrete a fluid of an offensive musky scent which makes the shrew distasteful to some carnivorous birds and beasts.

The food of the shrew consists of worms and insects of all kinds—slugs, snails, and even young frogs. From the enormous amount of grubs and slugs which they devour, the shrew is a great benefactor to the agriculturist. As it is in every other respect perfectly harmless to man or to his crops, it is deserving of close protection at our hands. Nevertheless, in past times and even at the present day the shrew was persecuted by country people. It was thought to be very mischievous to cattle, and able to poison them. It was believed, too, that it produced lameness in the foot of man or beast if it ran over that foot, and for the supposed harm done by the shrew the practice arose of applying to a particular ash-tree for a remedy. A tree was chosen in which a cylindrical hole or tunnel existed, or, in default of this, a long hole was bored with an auger. Into this tunnel in the wood a poor little shrew-mouse was thrust alive, and the rest of the hole carefully blocked up. When it was supposed that the shrew's body had decayed and fused with the substance of the tree, thin twigs of this "shrew ash" were potent as remedies for the poison caused by a shrew running over or biting any creature, which had only to be touched with the twigs to instantly recover. Our Board of Agriculture ought to endeavour to spread throughout the kingdom into the rustic mind the conviction that both species of shrew are absolutely beneficial to man, in that they are engaged incessantly in the destruction of noxious insects. Shrew-mice should be protected by law, and it should be made a penal offence to kill one.

The female shrew makes a nest in the spring in some hole or depression in the ground or in a bank. The nest is constructed of soft herbage, is covered at the top, and entered from the side.

Shrews utter faint squeaking cries, sometimes so shrill as not to be audible to every person. They are very pugnacious, and their spiteful attacks on each other have given rise to the adjective "shrewish" in reference to similar actions on a larger scale in the human species. The name, which is an Anglo-Saxon word, is related to such meanings as *shred*, *shrive*, and relates to the action of cutting, biting, or reproving.

At certain seasons of the year shrews are often found dead on paths and roadways. This is generally during the autumn, and is now attributed, with some probability, to the starvation induced by want of insect food at this season. These animals generally hibernate during the winter, taking refuge in holes or crevices made by other animals.

The distribution of the common shrew again leaves out Ireland, in which country it is totally unknown. In England and Wales and in Scotland its distribution almost coincides with that of the mole, as does also the length of its residence in Britain. It is absent from the big islands off the west coast of Scotland, and from the Hebrides. Outside Great Britain the shrew is found round the northern regions of the world—Europe, Asia, and North America.

Sorex minutus. The Lesser or Pygmy Shrew

This little creature is the smallest British mammal. Its body is about $1\frac{3}{4}$ in. long and the tail about another $1\frac{1}{2}$ in. The tail has rather a marked fringe along the upper surface. There is a slight difference in the teeth between the Lesser Shrew and the larger form. The first upper incisor is not so long and prominent a tooth as in *Sorex vulgaris*. The fore feet are also shorter proportionately. The general colour is brown above and grayish-white on the under part. The brown of the head and back displays almost an orange iridescence, and the arrangements of the silky hairs recalls the beautiful "watered"

appearance of the gorgets in humming-birds. It is, in fact, an exquisite little creature. It breeds between April and August, and produces from five to seven young, occasionally, however, as many as ten. As in the common shrew, the young are blind, naked, and toothless when born, somewhat suggestive of the incompletely finished young of some marsupials.

The distribution of the lesser shrew in the British Islands is very different from that of the common shrew. It is found abundantly in Ireland and also in the Hebrides and some of the large islands off the west coast of Scotland. In the rest of Scotland and in England it is much less abundant, yet it is more frequently met with in the south of England than in the north. Its fossil remains in Eastern Ireland would appear to date back as far as the beginning of the Pleistocene period. Outside Great Britain the lesser shrew extends its range across Central Europe and Asia to the borders of the North Pacific Ocean, but, unlike the common shrew, it does not reach North America.

GENUS: *CROSSOPUS.* AQUATIC SHREWS

Crossopus fodiens. THE WATER SHREW

This genus, though included within the sub-family of the True Shrews, differs from them in several important points. As regards the teeth, there is only one premolar (the fourth) on each side of the upper jaw, otherwise the dentition is fairly similar to that of the common shrew. The ends of the teeth are brownish-red, as in the other shrew-mice, but they "wear" white with age and use. The outer ears are small, and scarcely distinguishable amid the fur. The tail is long, and its under side is fringed with long hairs. There are also fringes of the same kind on the feet. The snout is decidedly shorter and broader than in the common shrew. The eyes are small, and the hind feet are large and adapted for swimming. The opening of the female generative organs, though not actually coalescing with the anus, is situated very close to that opening, and is enclosed with it in a ring of integument. In size the

water shrew is decidedly larger than the common shrew. Its body is about $3\frac{1}{4}$ in. long, and the tail measures a little over 2 in., thus giving a total length of over $5\frac{1}{4}$ in. The colour is blackish-gray above and white beneath, the two tints being rather sharply divided. Sometimes the lower surface of the body (that is to say, the outer edges of the hind and front limbs, the throat and belly) are tinged with russet-red, this

THE WATER SHREW (*Crossopus fodiens*).

warmer tint nearly always making its appearance on the throat. The upper surface of the tail is black, but the stiff hairs fringing its lower surface are white, and the same occurs with the hairs fringing the outer surface of the feet. When swimming under water the animal has quite a gray appearance, as many minute air bubbles adhere to the points of the hair and impart to the coat a silvery sheen.

The female is a little smaller than the male. The breeding

season occurs during the spring, and in May the female gives birth to from five to ten young ones, which are housed in a circular cavity at the end of a long winding burrow. The water shrew drives a passage upwards into this nest, commencing underneath the surface of the water on the side of the bank, while the nest has, of course, another passage leading to the air. The entrance to this upper passage is generally approached by a number of paths radiating in different directions. The interior of the nest is lined with soft grass. Mr. Trevor-Battye describes the young water shrews as being most sportive and amusing little creatures, which may be seen playing and chasing one another on the ground outside the burrow. When the creature is alarmed it generally enters its burrow from the hole made under the surface of the water.

Its swimming and diving powers are remarkable, and resemble those of the otter. In swimming it moves chiefly by the action of the hind feet, which paddle alternately so as to impart a wriggling motion to the body. As a rule it swims on or close to the surface, constantly putting its nose out of water. Its body flattens and spreads out, the long flattened tail acts as a rudder, and the fore paws are generally drooping and inactive. The water shrew frequently seeks for its food at the bottom of the stream, turning over stones in its hunt for small crustaceans or water insects. It devours insects both on land and in the water, fresh-water shrimps, frog spawn, tiny fish, fresh-water molluscs, and even carrion.

The range of the water shrew in Britain is entirely confined to England and Wales (where it is very common) and Scotland (where it is rare). It extends to the extreme north of Scotland, but has never been obtained in the Hebrides or any of the other islands off the west coast of Scotland. It is quite unknown in Ireland. Its existence in England dates from the beginning of the Pleistocene Epoch. Elsewhere in the world the water shrew seems to extend across Central Asia to the Altai Mountains of Siberia. It does not reach America.

CHAPTER V

ORDER: *CHEIROPTERA.* THE BATS

IN the Silurian period of the Primary Epoch, before ever a vertebrate probably had evolved from a mollusc or an ascidian, the first real conquest by animals of the land and of the air commenced when from some form of many-legged worm or centipede the insect developed into the first lord of Creation, in that he took possession of the dry land and of the air. No doubt prior to his evolution crustaceans had turned into scorpions, and worms (using the word in its widest sense for primitive invertebrates) into centipedes. But though these might have crawled out of the water (in which element animal life originated) on to the mud, or even the sand and the rock; nothing that we know of, before the insect, commenced to fly. Then began the Scourge of Creation, the incarnation of evil, and at the same time the provocation to higher development. The abundance of insects on land and in the air became so great that when the early vertebrates had developed into fish and were without rivals in the watery covering of the earth's surface, insects proved the bait that drew the fish to land and turned it into an amphibian. The amphibian grew into a reptile, still mainly pursuing insects (some of which at that day and subsequently were as big as fowls). Some of these large crocodile-like amphibians no doubt returned to the water to eat the fish, their lowlier brethren ; and the earliest reptiles ate amphibians and fish as well as insects. But still the growth and predominance of insects incited to fresh developments, and an ancient group of reptiles took to the air to pursue their prey and became huge flying dragons. Other reptiles

developed into birds, still with the pursuit of insects as their magnet. The earlier mammals no doubt were largely insectivorous, and descendants of this type exist but little modified at the present day in hedgehogs, tree-shrews, moles, shrew-mice, and tenrecs.

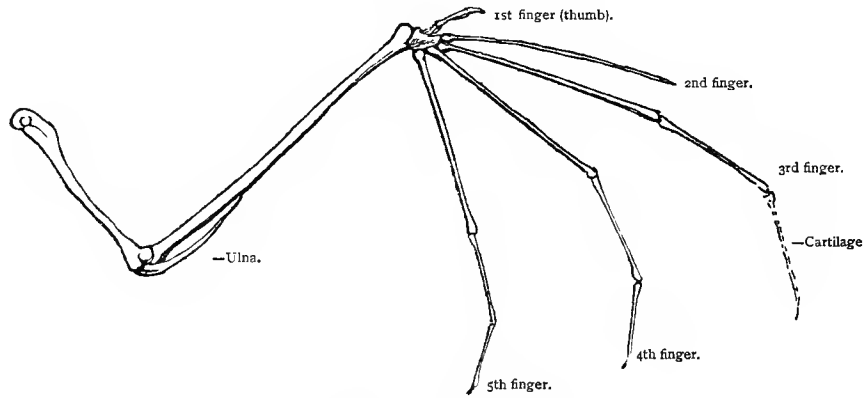
The earliest Insectivores were no doubt content to pursue insects in and out of the herbage, into the soil, and up on the trees. Once they had taken to a tree life their jumping and leaping through the air after flying insects became inevitable, and they learnt to do as flying squirrels—even the common squirrel—have done: to stretch out their fingers, arms, and the loose skin of the body to act as a parachute and break a fall. Later on, provided with a great membrane of stretched skin (such as the cobego of the Philippine Islands possesses), they strove to beat the air with their webbed hands, to turn a downward swoop into an upward flight, or to postpone descent. The hands, like those of certain lemurs, grew more and more long and slender-fingered, and the Insectivore had become a bat.

The exact origin of the Bats is still a matter of dispute. On the whole their nearest affinities in structure are with the Insectivora rather than with the Lemurs, to which in several points some of them offer misleading resemblances. Any one who in Africa has possessed a galago[1] will have been struck with the extraordinary resemblance in its movements which this creature offers to the bat. It jumps upwards, downwards, or horizontally through the air, starting with a tremendous spring from the hind legs, but aided, no doubt, by the large outstretched hands and loose skin of the fingers. The galago literally seems to fly through the air from a table to a window, where with unerring aim it will snap up some insect that has attracted its attention. In the position of the mammæ (which in all bats are reduced to two and are placed on or near the breast), in some points connected with the teeth, and, as regards the fruit-eating bats only, in the superficial aspect of the head, the bats certainly offer points

[1] A species of lemur only found on the African Continent, varying in size from that of a small cat to the bulk of a rat.

of resemblance to the lowest of the Primates. On one point they differ markedly. The thumb and generally the big or first toe on hands and feet in all the Primates down to the lowest of the Lemurs is armed with a nail, and not with a claw, while there is a strong tendency to develop flat nails instead of claws on all or several of the fingers. But the thumb and the big toe in the bats are terminated by curved claws not in the least resembling a nail.

As regards the terminations to the phalanges of the hands in all bats, there is very rarely a claw at the end of the



SKELETON OF A BAT'S HAND.

second finger,[1] but in the rest of the fingers the attenuated terminal joint of bone is entirely unarmed, and there is nothing to indicate whether it was originally furnished with a claw or a nail. The proportionate length of the fingers in the bats is not dissimilar to what obtains amongst the Primates, the third finger being the longest. The second, or index finger, tends towards neglect and degeneration in the bats, but in the fruit-eating sub-order still has three joints or phalanges, and is terminated by a small claw. Even among the fruit-eating bats the second

[1] A remarkable feature of all existing Lemurs as opposed to other existing Primates (monkeys and man) is that the second (our first) finger is armed with a claw, and not a nail.

finger is joined at its tip to the third finger. In the insect-eating bats it has never more than two joints, and sometimes one, or none at all, and is pressed closer and closer to the strong third finger until in some species its rudiment is hardly discernible in the membrane. In the fruit-eating bats the hallux, or big toe, is well developed and armed with a big claw ; so also is the fifth toe. In one genus of bats the hallux is opposable to the other toes, like the big toe in the hind feet in lemurs and monkeys. The hind limbs are almost directed backwards at right angles to the spine and pelvis in order to support the flying membrane. In the fore arm the radius becomes a much-bowed and very strong bone, while the ulna shrinks to a mere splinter.

In the teeth there are these points to be noted :—The upper incisors are never more than two in number on each side, while the lower incisors may number three pairs. The earliest known lemurs had three pairs of incisors in each jaw, but in all modern lemurs, monkeys, and anthropoids the formula never exceeds two pairs in each jaw. Some Insectivores possess the normal three pairs in both jaws, but in that group there is a tendency towards the loss and specialisation of the lower incisors. This is the opposite to what prevails in the bats, in which, where a change takes place, it is usually in the direction of diminishing the number of upper incisors.[1]

The mammæ are never more than two in number, and are placed on the breast. In the external and internal organs of generation the resemblance of the bats lies almost equally with the Insectivora and the lower Primates. The brain is of low development, and is that of an Insectivore.

This order is divided into two clearly marked sub-orders, the *Megacheiroptera* (fruit-eating bats) and the *Microcheiroptera* (usually insect-eating bats). The first of these sub-orders hardly comes within the purview of this book, as no form of this group has ever been known to exist in Britain or in any part of Europe.

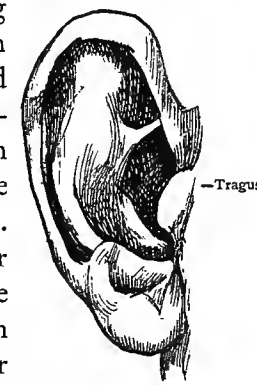
[1] This tendency to increased degeneration in the lower incisors exists to some extent in the fruit-eating bats, which also never possess more than two pairs of incisors in either jaw.

Its range is confined mainly to Southern Asia and Australia, with a few representatives in Madagascar and Africa. The fruit-eating bats would seem to be a later development in time than some of the insectivorous forms; yet, though specialised in some directions, they must have evolved from a more archaic type of bat than any now existing, since they retain the original three phalanges of the second finger (which is also provided with a claw), the long muzzle, large eyes, simply constructed ears without a tragus, and generally simple nose.[1] On the other hand, their molar teeth (except in one genus) are devoid of cusps, are smooth, and are marked with a longitudinal groove. The fruit-eating bats include the largest specimens of the order, and as a rule are much larger than the insect-eating sub-order.

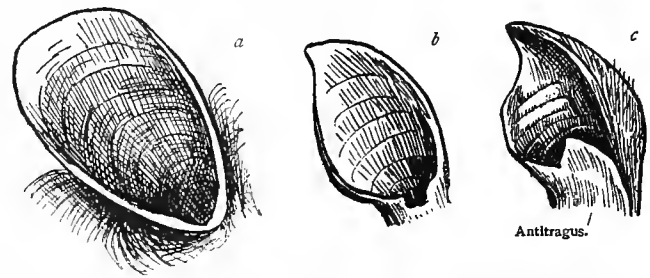
The *Microcheiroptera*, indeed, tend towards diminutive size. Unlike the fruit-eating bats, they are almost world-wide in distribution, only excepting the Arctic and Antarctic regions from their range. The crowns of the molar teeth are set with sharp cusps separated by transverse grooves, and not longitudinal, as in the fruit-eating bats. As already pointed out, the index finger never has more than two, and usually only one phalanx, which may be quite rudimentary. The lower incisors are, with very few exceptions, more numerous than those in the upper jaw. The ears, which sometimes attain exaggerated development, beyond anything met with in any other mammal, are signalised by this peculiarity, that the outer and inner sides of the ear conch start separately at their base, and not from a common meeting point. Moreover, the tragus, or forward flap of skin (which in the human species guards the entrance to the inner ear), often attains an excessive and extravagant development. There is nearly always something strange or eccentric about the nostrils. These are marked in many species by an excrescent growth, occasionally of extravagant dimensions and intricacy of pattern. The fantastic ornamentation of the nose and muzzle sometimes includes the lower lip. The eyes are invariably small, and in some species are scarcely functional.

[1] Though the nostrils may sometimes be prolonged into tubes.

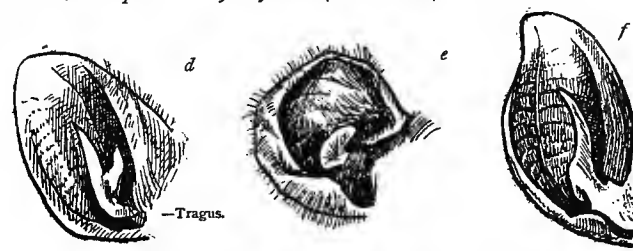
All bats are mainly nocturnal in habits. They never produce more than two, and usually only one, young at a birth. They only seem to breed once in the year, in the spring-time. The period of gestation probably varies in the insectivorous bats from three months to a month and a half. The young at parturition are of fairly large size, but are blind and naked. As they emerge from the body of the mother they are received into a bag formed by the forward-curled tail and its membrane on either side. Thence, after being licked over and cleaned by the mother, they are hoisted up by the fingers of the wing to the mother's breast. Here they cling tightly with their own wing membranes, thumbs, and hind feet, thus spreading themselves across the chest of the mother and fastening on to one of the nipples. Some little time after birth the mother constantly guards the young from observation by folding one wing over the body, suspending herself by the thumb of the other.



A. Human Ear for comparison.



B. Ears of Pteropodid and Rhinolophid Bats, *without* tragus.
a. Pteropus. b. Cynonycteris (*Pteropodidæ*). *c. Rhinolophus.*



C. Ears of Vespertilionid and Nycterid Bats, *with* tragus.
d. Megaderma (*Nycteridæ*). *e. Pterygistes noctula. f. Myotis bechsteini.*

EARS OF BATS, TO SHOW TRAGUS, ABSENCE OF TRAGUS, AND DEVELOPMENT OF ANTITRAGUS. (The three lower examples much enlarged.)

Bats fly swiftly and with rapid swoops, but they also flap the membrane of the wings. The strong interfemoral membrane which stretches between the hind legs and the tail, and, in a species of British bats, extends to the very tip of that organ, acts as a rudder to some extent ; though the direction of the flight (as in soaring birds) is also effected by shifting the axis of the body. The skin which forms the flying membrane, and which stretches from the fingers to the heel and the tip of the tail, is exceedingly thin and silky in texture, almost, if not entirely, devoid of fur (though hair may grow on the inner surface of the arms, and fine hairs on parts of the membrane). It is in appearance very like the silk stretched over the rods of an umbrella, and has sometimes a "watered" aspect. This is caused by the network of nerves and veins, which makes the wing surface extremely sensitive to pulsations of the air, and assists the bat, no doubt, in avoiding obstacles.

Bats, of course, can walk and climb ; in fact, they probably originated from a climbing and arboreal type of Insectivore which developed huge hands like those of the aye-aye lemur and spread them over the tree trunk. They can also swim ; at least several of the *Vespertilionidæ* have been observed swimming in streams into which they had fallen. Their present method of progression on the ground or on trees is as follows :—The great hands (*i.e.*, wings) are folded back along the sides, while the hooked thumb is extended. The bat, in fact, walks on its bent wrist. The wrist is pushed forward, the strong claw of the thumb grips some inequality, then the foot of the same side of the body is moved forward, then the other side of the body is raised by the extension of the other hind foot, and lastly the thumb claw of the other wing advances. So the body moves along by a series of sidelong plunges. It is, however, very much quicker at climbing up a tree than in moving along a smooth surface.

When sleeping, bats hang perpendicularly from some projection by the claws of their hind feet, generally depending from one foot, the knee of which remains crooked. The tail membrane and the wings are folded over the stomach.

The insectivorous bats, especially those which dwell in

Photo by George Jolly.

LONG-EARED BAT (*Plecotus auritus*).

Photo by George Jolly.

COMMON BAT HANGING BY ITS THUMBS.

Photo by George Jolly.

COMMON BAT (*Pipistrellus pipistrellus*) HANGING BY ITS FEET.

Photo by George Jolly.

BAT HANGING WITH FOLDED WINGS AND TAIL.

To face p. 82.

Britain, depend but little for guidance on their sense of vision, the eyes being very small, and often partially concealed under the large ears and the fur. They are, however, extremely sensitive in their hearing, and the considerable ear surface presented by some of them to the air undoubtedly guides them in their avoidance of obstacles by receiving and recording the air currents which may indicate by their vibrations the proximity of any solid body. The extraordinary development of cartilage round the nose in several families of bats is, no doubt, an additional organ of sensation.

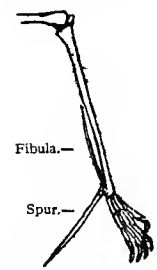
In most parts of the temperate regions and in Britain bats hibernate ; that is to say, they retire in companies to a sheltered, dark place of security, where they suspend themselves by their hind claws, often holding on as well to their neighbours, so that they are sometimes crowded together in large numbers. The period of hibernation varies according to species. Some bats "go into retreat" in August, others in October or November, while the commonest of British bats, the pipistrelle, may only sleep for two or three weeks at a time during the winter, emerging from its hiding-place on a mild day, and pursuing such insects as may remain to haunt the air. Most bats are out again at the end of April, and breeding goes on amongst them at the end of the hibernation.

Although the food of this group is mainly insectivorous, most of them will eat meat greedily when they can get it, and even fish ; while some species of microcheiropterous bats in America live wholly on fruit or on fish, or, in the true vampire, on the blood of live beasts.

FAMILY : *VESPERTILIONIDÆ.* THE TYPICAL BATS

This is the largest family in the whole order. It extends to something like 190 species, though the number of genera is considerably less. This group in some respects is the least specialised of the bats. Its members have, as a rule, three pairs of incisors in the lower and two in the upper jaw. In the upper jaw there is a remarkable open space between the inner pair of incisors. The ears are furnished with a tragus, and

the whole of the tail, practically, is contained within the flying membrane. The index finger in each hand has two phalanges, or joints. These bats, in common with most of the Microcheiroptera, have developed a bony spur (calcaneum), which grows almost at right angles from the ankle (inwards towards the tail), and serves to support the interfemoral membrane. This membrane is also supported by what appears to be another spur of bone, but which is really the stumpy fibula.[1] The apertures of the nostrils, though sometimes hidden in deep grooves, are without any excrescence or "nose leaf," except in two non-British genera in which a rudimentary excrescence or nose leaf occurs above the nostrils.



BONES OF A BAT'S LEG AND FOOT.

GENUS: *VESPERTILIO*[2]

In this genus of bats, and in the two succeeding genera, *Pterygistes* and *Pipistrellus*, the ears are comparatively small, and situated rather wide apart. The outer margin of the ear is extended to and ends at the angle of the mouth, where it thickens into a rounded lobe. The inner margin of the ear curls round somewhat sharply at its base into another lobe, situated quite close to the small eye. The tragus, or flap covering the entrance to the ear, is short and thick, and curves towards the inner margin of the ear. The muzzle is short, broad, and blunt, rather like that of a frog, and there are prominent swellings

[1] The smaller and second bone of the leg.

[2] In the classification of British bats the author follows—not altogether confidently—the authorities at the British Museum (Natural History) in their most recent nomenclature, and departs somewhat widely from that great authority on bats, the late Dr. G. E. Dobson. The new classification of British bats is due to the researches of an American zoologist, Mr. G. S. Miller, and of Mr. Oldfield Thomas. In this arrangement the old generic term *Vesperugo* is abolished (according to the law of priority) in favour of *Vespertilio*, and is further divided into *Pterygistes* and *Pipistrellus*. The *Vespertilio* of Dobson and others becomes *Myotis*. *Vesperugo discolor* becomes *Vespertilio murinus*, while the totally distinct *Vespertilio murinus* of Dobson (*Myotis myotis*) is not always recognised as a British species.

of the glands between the eyes and the nostrils, making the face even rounder and wider. There is a small additional expansion of skin behind the bony spur. As regards the teeth, there are two pairs of incisors above and three pairs below; only one pair of premolars in the upper jaw and two pairs in the lower jaw; and, of course, three pairs of molars above and below.

SEROTINE BAT (*Vespertilio serotinus*): to show (*a*) shape of ear; (*b*) naked three-cornered space on under lip; (*c*) remains of sucker disc on ball of thumb; (*d*) point of departure of wing membrane from base of toes; (*e*) calcaneum or spur; (*f*) post-calcaneal lobule and interfemoral membrane; (*g*) degree to which tail projects beyond interfemoral membrane.

Vespertilio serotinus. THE SEROTINE BAT

In this species the head and muzzle are particularly flat. The front of the face is almost denuded of hair, but there is a slight moustache on the upper lip. The thumb has a callosity at its base, which is probably the remains of a suctorial disc possessed

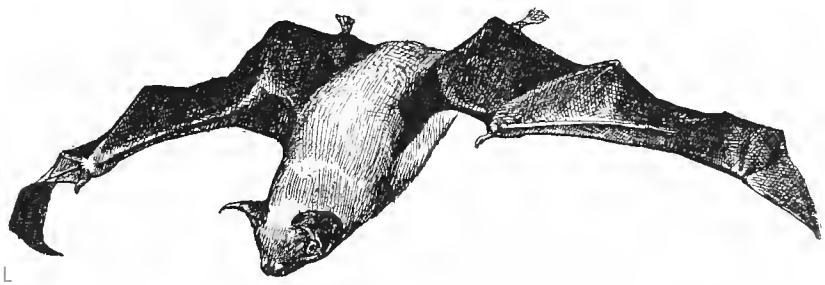
by other species of bats attached to the base of the thumb or the soles of the feet, and enabling them to adhere more tightly to smooth surfaces over which they are creeping. The use of this disc has evidently been lost in the Serotine Bat, but its rudiment remains. The upper incisor teeth of all old specimens betray a tendency to divide in two at the extremity. They are marked with a groove even when this has not deepened into division. The lower incisors betray a similar tendency to split into three points. There are two pairs of incisors in the upper jaw and three in the lower, one pair of canines in both jaws, one pair of premolars above and two pairs below, and three pairs of molars in each jaw. The length of the head and body is about $2\frac{3}{4}$ in. the tail measuring 2 in. more. As regards colour, this bat is generally a dark brown, paling to yellow-brown or yellowish-gray on the under parts. The wing membrane, of course, as in all British bats, is a dark sepia or blackish-gray. The serotine bat produces a single young one at a birth, this event taking place about the month of June. In the British Islands its distribution seems to be confined to a small portion of the south of England between Cornwall and Essex. Outside England its range is so world-wide as to exceed that of any other bat, for it is found over all Temperate Europe, Asia, and North America, also in North Africa, and even, it is said, in parts of South America. It has been named the "serotine" bat from its habit of only making its appearance late in the evening, and not at sunset. It is not as gregarious in its habits as other members of the genus, and is accustomed to hibernate singly, taking up its abode in hollow trees.

A species allied to the serotine is the Parti-coloured Bat (*Vespertilio murinus*). This bat has the colour of the upper parts dark brown, spangled with yellowish-white, owing to the last quarter of the long hairs being that colour. The under parts are yellowish-white, with gray as an under colour. In the middle of the chest and stomach there is a large patch of reddish-brown flecked with white. It is about the size of the serotine bat—perhaps a little smaller—with a tail proportionately somewhat

longer. Only one British example of this bat has been obtained with certainty up to the present time, and that was caught at Plymouth. It was no doubt accidentally introduced by some ship. Its actual area of distribution is confined to Central Europe, Northern Africa, and Temperate Asia.

Genus: *PTERYGISTES*

This genus differs from the foregoing in the premolar teeth, two pairs above and two pairs below. In the upper jaw the first premolar is very minute, and is pushed inwards behind the canine.



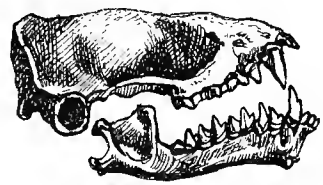
Great or Noctule Bat (*Pterygistes noctula*).

Pterygistes noctula. The Great Bat, or Noctule

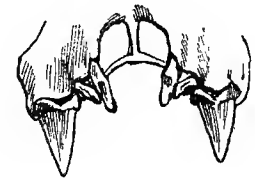
This is the largest of British bats, and the head and body, from the tip of the nose to the root of the tail, are nearly 3 in. long. The tail is another $1\frac{1}{2}$ in. The stretch of the wings from tip to tip is sometimes nearly 14 in. long. The head is flat and broad and the muzzle is expanded, the nostrils being very broad, and separated from one another by a large space of tumid skin. The ears are wide apart, somewhat short, but broad and deep. The external margin of the ear has a deep fold near the base, and it is continued downwards below the corners of the mouth. The tragus, or earlet, is short, and is very narrow at its base, but extends into a kidney-shaped lobe of thick skin covered with minute papillæ. The accompanying illustration shows the remarkable space in the skull below the nasal opening

and between the inner pair of upper incisor teeth. The tip of the tail projects for less than one inch beyond the membrane, and has a tendency to curve downwards and inwards towards the belly. The wing membrane in this bat starts from the beginning of the ankle, and not from the base of the toes. The eyes in this species are placed very close to the inner margin of the ear, and are almost hidden by that organ. The fur of this animal is soft, long, and rather silky. In colour it is a yellowish or golden-brown, slightly paler below. The nearly bare ears, the muzzle, and the membrane are a dusky brown-gray.

The period of gestation in this bat would seem to be as



SKULL OF NOCTULE BAT
(1⅓ times natural size).

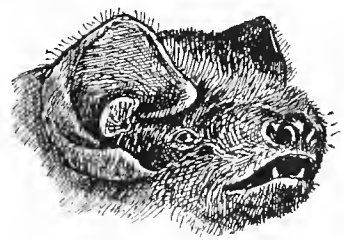


FRONT OF SKULL OF NOCTULE BAT,
To show separation between incisor teeth and large canines (3 times natural size).

much as two months. It has not been known to produce more than one young at a time in England, but on the Continent two at a birth is a common occurrence. The young, as in all these bats, are born blind and naked.

The Noctule flies high and rapidly, and when in pursuit of insects often utters harsh or shrill squeaks. Though a most cleanly animal in keeping its own fur in proper condition, it emits a very offensive odour; and when a number of these bats have congregated in a hollow tree, or in the eaves of a house, the effluvia emanating from them is markedly disagreeable. This bat would appear to feed largely on beetles. It prefers these and other insects that fly to those that crawl, but it will eat meat greedily, if such diet is obtainable. Specimens kept in captivity (and this is a trait recorded of many bats belonging to both sub-orders) are observed to eat more than their own weight in food. This passes so quickly through their system that they

soon regain their normal weight. The noctule emits a very offensive smell from glands in the mouth. It would seem to possess a relative insensibility to the effects of poison. One living specimen had a drop of prussic acid placed on its tongue, and was some time dying. Meantime its parasites (all bats are much afflicted with fleas and lice) dropped off dead from the poisoned blood.



HEAD OF NOCTULE BAT (nearly twice natural size).

The range of the great bat in Britain is confined to the midland counties, the south and south-west. Yorkshire and Lancashire are its northern limits. It has not been found in Wales or Scotland, but does appear to occur in Ireland, specimens having been obtained in the north-east of that island. It is, apparently, commonest in our midland counties. Outside England, it is found throughout Temperate and Southern Europe and most parts of Asia ; also nearly the whole of Africa.

Pterygistes leisleri. THE HAIRY-ARMED BAT

This species closely resembles the noctule, but it is a little smaller, and there is some difference in the incisor teeth, those in the lower jaw being ranged in a semicircle with no overlapping, whereas the incisor teeth in the lower jaw of the noctule are crowded, and the outermost pair of upper incisor teeth in the species now described are not so disproportionately broad and short as in the noctule. The length of the head and body of the Hairy-armed Bat is about $2\frac{1}{4}$ in., while the tail measures nearly $1\frac{3}{4}$ in. The bat takes its English name from the fact that the inner surface of the fore arm, instead of being covered with bare skin, is furred with fine, short hairs as far down as the wrist. The side of the fore arm in the noctule is also hairy, but not to such a marked extent. The nostrils are crescent-shaped, and there is a large naked gland near the angle of the mouth. The outer margin of the ears does not reach as far as the corner of the mouth, and the ears are hairy on the inner surface. The

thumb is rather short, and armed with a somewhat feeble claw. The fur of the body is long; deep brown at its base and chestnut on the surface, but tending towards gray on the belly. The colour of this bat varies, however, and English specimens seem to be more chestnut in tone than those of the Continent, which are often a dark sooty-brown. The head of this bat is rather less rounded and blunt than is the head of the noctule. The snout projects markedly over the lower lip.

The distribution of *Pterygistes leisleri* is still not very clearly known as regards the United Kingdom. Hitherto it has been recorded from the western midlands of England, the Lake District, and the north-east and east of Ireland. Outside England, the bat ranges right across Central Europe to Temperate Asia, as far south as the Himalayas. It is also found in Madeira and North Africa.

The flight of this bat is said to be at a higher elevation than that of the noctule, and it flies in a zigzag fashion, as if uncertain as to its direction. This desultory manner of flight appears to have been remarked in all specimens under observation.

Genus: *PIPISTRELLUS*

It is not clearly established that the differences between the bats of the preceding genus and those of *Pipistrellus* are generic in their importance. The author, however, follows Thomas, Miller, and Allen in this arrangement. The upper incisors in *Pipistrellus* are longer and the inner pair more markedly bifid (grooved into two points), while the first premolar is less reduced and displaced than in *Pterygistes*.

Pipistrellus pipistrellus. The Common Bat, or Pipistrelle.

The second name of the commonest species of bat in the British Islands is apparently a French dialect name given to this bat in Eastern France, and adopted specifically by Schreber, a German writer on mammals, in 1775. The country name applied to this and other bats in England is "flittermouse," an Anglo-Saxon combination that explains itself, and which is paralleled by

the German *Fledermaus.* "Bat" is a word of Scandinavian origin, and is a corruption of *bakke*, which again is an abbreviation of *blakke*, a word which meant "to flap." This term "bat" came into use in English after the Norman Conquest, and gradually spread from the east of England into the literary language, "flittermouse" only surviving in country speech.

The Pipistrelle is the smallest of the English bats, and measures at most $1\frac{3}{4}$ in. from the tip of the nose to the base of the tail, while the tail is scarcely $1\frac{1}{2}$ in. in length. Its head is more rounded than that of the hairy-armed bat, but the nose and muzzle are less blunt than those of the noctule. The ears are fairly large, and are nearly triangular in shape, resembling in outline very much the wings of a butterfly. There are well-developed glandular swellings on the muzzle, and the face, including the region of the eyes, is nearly devoid of hair in full-grown specimens. The thumb is rather weak and the feet are small, with very fine claws. The innermost pair of the upper incisor teeth have bifid crowns—that is to say, they seem almost as though they were divided into two teeth in the middle; nor are they set quite straight in the jaw, for the innermost divisions of these teeth project forward more than the outer section. There are four incisors in the upper jaw and six in the lower. Those in the lower jaw are divided into three lobes, in contrast to the upper incisors, which, as already mentioned, have each of them two divisions. There are two pairs of premolars and three pairs of molars in each jaw. On each side of the nose above the upper lip is a protuberance covering the sebaceous glands, which add to the swelling of the muzzle. The eyes are very small and deeply sunk. Over each eyebrow is a small wart, from which spring a few black hairs. On the top of

HEAD OF PIPISTRELLE OR COMMON BAT
(*Pipistrellus pipistrellus*).

the forehead is a tuft or crest of rather long hair, which gives a lofty appearance to the head.

The fur of the pipistrelle is long and silky, and is in general reddish-brown in the upper parts, fading into gray on the belly, a gray tinged with brown, however, owing to the tips of the hairs being chestnut. The reddish-brown lightens into a yellowish tint on the forehead and round the ears. The naked parts of the muzzle and ears and the flying membranes are a dusky tint, sometimes a blackish flesh-colour. The young of this, as of so many other species of *Vespertilionidæ*, are born naked, and the first hair they acquire is of a much grayer, duskier tone than the warm brown or reddish-yellow tints of the full-grown animal.

The pipistrelle would appear to breed later in the year than the noctule, females being generally taken with young in the month of July. So far as is known, the common bat only has one young one at a time. It is asserted, however, that the Continental form of the pipistrelle, as of the noctule, produces two young at a birth, and certainly this fact was recorded by Pliny.

The pipistrelle hibernates for two or three months in the middle of the winter, though it may occasionally emerge from its retreat on a sunny winter's day. Its hibernating sleep seems rather to depend on the absence of insect life in the air than on temperature, for although the pipistrelle may appear in flight in the middle of March, it only emerges then because insects likewise have come out into the air. It does not frequent trees like the noctule, but retires during the daytime and during its hibernation to crevices in walls, and nooks and crannies in roofs, rocks, and caverns. It will sometimes crawl into the spouts of disused pumps. During the summer-time it often passes its midday sleep in the vicinity of farmyards, no doubt because in the evening it can whisk about such cattle as may be sleeping in the fields, and snap up the flies settled on them.

The pipistrelle progresses over a horizontal surface at a much quicker rate than most bats, almost seeming to run. It keeps the head depressed and near the ground, and uses the tail as an additional limb for propelling itself. The tail in this animal

tends to curve inwards under the body. The bone projects a short distance beyond the membrane, and almost acts as a kind of spring. The tip of the tail is forced against the ground on each side alternately, moving in concert with the hind foot, and having a slightly prehensile character. It is of great use to the body in ascending or descending an inclined surface. Apparently it also assists the pipistrelle to rise into the air from the ground by acting as a spring with the hind feet. The flight of this bat is quick, but unsteady and zigzag, like that of a moth. It does not fly ordinarily very high, as a rule not much more than twenty feet from the ground.

The food of the pipistrelle consists of all the smaller flying insects and moths. It consumes large numbers of gnats and flies, and is also fond of raw meat. This common bat appears occasionally in broad daylight, drawn out perhaps by hunger. Ordinarily it does not make its appearance in the open till the sun has set, though it is an early bat compared to the serotine or noctule, and may not infrequently be seen still flying about at sunrise on a summer morning.

The distribution of the common bat over the British Islands is practically universal. It is met with all over Ireland, Scotland, the Hebrides, the Isle of Man, Wales, and England. It is found all over Europe and Temperate Asia, and in India its place is taken by a form so closely allied as hardly to be specifically different. This Indian form extends as far south as Australia. It is also found in Northern Africa. Its fossil remains apparently date back in England to the close of the Pleistocene period.

Genus: *MYOTIS*

This genus is clearly marked by the possession in each jaw of three pairs of premolars and the same number of molar teeth, a characteristic which is shared by only two other genera (*Thyroptera* and *Myxopoda*) in the sub-order. The incisor teeth in the upper jaw (two pairs) diverge from each other. The ears also are narrow ; the tragus, or earlet, is long, narrow, and sometimes recurved outwards. The outer margin of the ear conch does not

grow down so low as the angle of the mouth, but starts on a line with the origin of the lobe of the inner margin of the ear; so that the ear, though long and provided with rather a marked tragus, has nevertheless a normal aspect. The muzzle is more pointed; the eyes are small and deep-set; the nostrils are simple and not projecting. In some respects these are the least specialised among the British bats.

Myotis dasycneme. The Rough-legged Bat

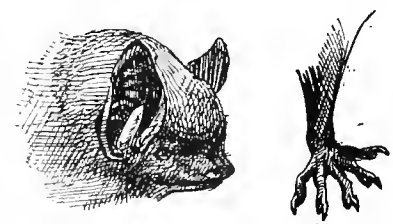
In this bat the bony spur which starts at right angles to the heel to support the membrane stretched between the thigh and the tail is unusually long, and extends for over three-quarters of the distance along the edge of the membrane from the ankle to the tail. The thumb is armed by a very large claw. The earlet, or tragus, has a blunt, rounded tip, and in some respects resembles the same feature in forms of *Pterygistes*. The ear-conch also is shorter, and the face is less hairy than in the typical Myotidine bats. In the teeth the first and second upper premolars are pushed inwards, so that the large third premolar nearly touches the canine. The fur on the upper surface of the body is blackish in the lower parts of the hairs, and light brown at their tips. The belly has a more "pepper and salt" appearance, as the hairs are white at the tip and black below. The size of this bat is fairly large. The length of head and body is nearly $2\frac{1}{2}$ in., and the tail, which is long, measures 2 in. more. The flight is vacillating and butterfly-like.

Until recently this bat was only represented as a British species by one example, captured on the River Stour, near Christchurch, where its captor, Lord Lilford, found it swimming. But subsequently it has been found in Warwickshire, and in several places in the south of England. Elsewhere its range extends through Central Europe to Asia.

Myotis daubentoni. Daubenton's Bat

This is a smaller animal than the preceding, not 2 in. in length, with a tail measuring $1\frac{3}{4}$ inches. Like the rough-legged bat, it

has rather large feet. The oval-shaped ears are three-fourths of the length of the head—*i.e.*, a little more than half an inch long. The wings when extended measure 9 in. across. The fifth or outer toe is somewhat separate from the others. The membrane of the wing arises from the side of the foot, much below the ankle. The earlet, or tragus, is moderately pointed, and measures about half the length of the ear. The face between the eyes and the nostrils is nearly naked. The upper incisor teeth are nearly equal in size, with wide notches between the bifid cusps. The second premolar in the upper jaw is much smaller than the first, but is not pushed inwards. The general colour of this soft-furred bat is reddish-brown above and grayish-brown below. The under surface may be sometimes almost white, but on separating the fur above and below the under part of the hairs is seen to be black or dark gray in colour. The membrane is the usual dusky dull black, but has a tinge of Indian red in parts, due, no doubt, in the living bat to the coursing of the blood through the veins. The eye, as usual, is very small, and is placed quite close to the inner margin of the ear.



HEAD AND FOOT OF DAUBENTON'S BAT.

Daubenton's Bat has a particular affection for the vicinity of water, and flies slowly and quiveringly close to the surface of this element. This, no doubt, is done in pursuit of insects, though as the bat is occasionally seen to stoop and dip its nose into the water, it may also be searching for minute floating water insects or dead fish. In captivity Bell states that they would soon become tame, and freely take milk, flies, or pieces of meat from the palm of the hand. When they had seized with their mouths an insect or piece of food that was rather unmanageable, they would make use of the wrist joint to push the substance into the mouth.

Daubenton's bat inhabits North Africa, Southern and Central Europe, and Asia. In England it has hitherto been observed most in the Western Midlands and Lake District. It seems to be

much less common in the east or south-east. It extends into Scotland as far north as Aberdeenshire and Banff, and has been found in the north, north-west, and south-east of Ireland.

Daubenton's bat is sometimes confounded with the notch-eared bat (*Myotis emarginatus*), a very doubtful British species, which is described on p. 102. It may be distinguished at once from the notch-eared bat by the absence of a very marked indentation in the outline of the outer margin of the ear. The feet in Daubenton's bat are larger proportionately than those of *Myotis emarginatus*, and there is scarcely any trace in the former of the two bats of that fringe of long hairs on the sides of the upper lip and muzzle which is so marked a characteristic of the whiskered and notch-eared bats. Daubenton's bat, no doubt, in its wide range from Ireland to Burma, and from Finland to North Africa, develops not a few local varieties which approximate towards other distinct species.

Myotis nattereri. The Reddish-gray Bat

This bat is just under 2 in. in measurement from the tip of the nose to the base of the tail, and the tail is a little over $1\frac{3}{4}$ in. long. The ears are nearly three-quarters of an inch in length, somewhat pointed at the extremity, but in general of an oval shape. The inner margin is turned outwards, and does not form any lobe by curving in the reverse direction towards the middle of the ear. The outer margin nearly meets the inner at the base, and its lower portion curls over towards the centre of the ear. The tragus is narrow, sharply pointed, and curves outwards. The eyes are very small. The nostrils are oval in shape and surrounded by a naked patch above and below, which is somewhat swollen. There is a thin moustache along the upper lip, and a prominent sebaceous gland on each side of the face above the lip. The head on the whole is rather small in size proportionately. This appearance is, no doubt, the result of the hair on the forehead and the nape of the neck being no longer than that of the body. The interfemoral membrane which connects the hind legs with the tail is supported by the calcaneum,

or long bony spur arising from the ankle, and on its outer margin this spur is somewhat notched, and fringed with stiff hairs. The colour of this bat is a light reddish-brown flecked with gray, as the tips of the hairs are grayish. The under surface of the body is sometimes nearly white in aspect, ordinarily a light silvery-gray. By this nearly white under part the reddish-gray bat may be easily recognised, as also by the fringe of hairs along the interfemoral membrane. The reddish-gray bat is very gregarious in habits, and is fond of frequenting caverns, the under side of roofs (especially in churches), and occasionally hollow trees. It is said to have a kindly disposition towards its comrades, and to be easily tamed by man; yet specimens that die in captivity are often half eaten by their comrades. The distribution of the reddish-grey bat in England is fairly common over the southern and midland counties. It has been found in the west of Scotland, and is occasionally met with in Ireland in the counties of Dublin, Wicklow, Cork, and Longford. Elsewhere its range appears to be limited to Central and Eastern Europe. It has not been recorded from Asia or from any part of Europe to the south of the Alps.

Myotis bechsteini. Bechstein's Bat

In this species the margin of the interfemoral membrane is naked. The length of the head and body is slightly over 2 in., and the tail is 1½ in. The ears are nearly an inch in length, and oval in shape. The tragus is a third of an inch in length, tapering to a point, curving somewhat outwards, and shaped a little like a scimitar. The narrow nose is rather depressed in the middle. The gape is very wide, extending to the base of the ears. The muzzle is rather long. The wing membrane extends almost to the base of the toes. The wings are broad, but

Head of Bechstein's Bat (nearly twice natural size).

not so long proportionately as in the species next to be described. The colour is reddish-gray above and light gray beneath, the base of the hairs on the belly being blackish, and their tips grayish-white. The flying membrane is nearly black in colour. This bat is forest-haunting. It resorts exclusively to hollow trees for shelter, and never enters buildings. It is also rather a solitary bat, and if not alone it is never found in larger numbers than twelve or thirteen, and they are generally all of one sex. Its occurrence in England was originally somewhat doubtful, as it was only known from specimens captured in the early part of the nineteenth century in the New Forest; but in 1902 Mr. J. G. Millais caught a Bechstein's bat at Henley-on-Thames. Elsewhere its range is confined to nearly all parts of Europe, from the south of Sweden in the north to the Pyrenees and the Alps in the south.

Myotis myotis. The Common Continental Bat

This is the largest species of bat ever recorded from Britain, as it probably exceeds in size (even in average specimens) the noctule, or great bat. But as this species, though so common on the Continent, is extremely scarce in England (where its recorded certain occurrences are only two in number), it can hardly be held to oust the noctule from its position as the largest British bat. The British bats are, however, imperfectly known, as this type of mammal is only interesting to specialists. Moreover, bats are far less easy to observe and to obtain (owing to their aerial and crepuscular habits) than other land mammals. Further research may establish more certainly the claim of this species to be considered a British mammal.

The *Myotis* bat sometimes measures $3\frac{1}{2}$ in. from the tip of the nose to the base of the tail, and the tail itself is over $1\frac{1}{2}$ in. in length. The ears are nearly an inch long, and the tragus nearly half an inch. The wings measure about 15 in. across from tip to tip. The eyes are exceptionally large in this group of bats (in some members of which the eye has almost become a negligible quantity), and they are not placed so close

to the margin of the ear. The forehead is very hairy ; but the nose is naked and smooth and prominent, extending a little distance beyond the lower lip. The muffle is wet, and the nostrils open at the side. The ears are inclined backwards, and are long and somewhat oval in shape. The tragus is erect, slightly curved, and rather sharp-pointed. The lower part of the inner margin of the ear is hairy. There is a slight moustache on the upper lip, and the area between the eye and the nostrils is swollen. The wing membrane arises from near the base of the

HEAD OF COMMON CONTINENTAL BAT (*Myotis myotis*). Natural size.

toes. The interfemoral membrane is covered with hair on the basal half of its upper surface. The first upper premolar tooth is small as compared to the third, and the middle premolar still smaller, and set rather back. The general colour of the body is pale reddish-brown above, and grayish-white beneath. The outer side of the ears is grayish, the inner yellowish. The colour of the membrane differs markedly from that of the bats hitherto described, in that it is not blackish, but pale yellowish-brown.

This bat only produces a single young at a birth, generally at the end of May. It frequents buildings and caverns, and it does not resort to forests or trees, nor does it associate with

other species of bats. It is gregarious with its fellows, but very quarrelsome. In combats which take place amongst these bats, much damage is done by the sharp teeth, strong jaws, and the stout hooks of the thumbs. These combats result in the wing membranes being torn to rags, and even the long arm bones being broken. Moreover, Mr. Lydekker records that specimens of this bat kept in India, in confinement, attacked, killed, and ate their weaker comrades.

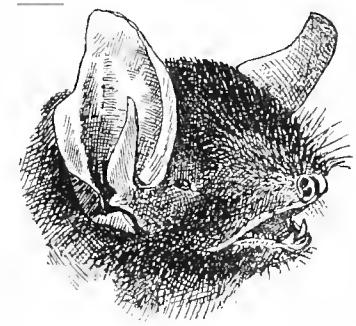
The Common Continental Bat is supposed to have been captured in a Bloomsbury garden in the early part of the nineteenth century, and it is thought that the British type in the possession of the Natural History Museum at South Kensington is one of the bats caught in the vicinity of the British Museum in Bloomsbury. Only one other certain instance occurs of its presence in England—about fifteen years ago, in Cambridgeshire[1]—though it has been reported, on probably mistaken evidence, to exist in Dorsetshire and the Isle of Wight. It is such a common bat in France, that, as it is quite able to fly across the Channel at its narrowest, there is no reason why it should not be found in the south of England. It is met with in most parts of Europe and in North Africa, and over the greater part of Temperate Asia. This bat is the *Vespertilio murinus* of Blasius, Dobson, Lydekker, and other authorities prior to 1898. It is now re-named *Myotis myotis*.

Myotis mystacinus. The Whiskered Bat

This is very nearly as small a bat as the pipistrelle. The length of the head and body is a little over 1½ in., and the tail is a little less than 1½ in. The ears are slightly shorter than the head. Their outer margins develop a notch (through the jutting outwards of the outer fold) not unlike that which is seen in the species next to be described. The tragus is erect and somewhat pointed, and a little more than half the length of the

[1] This specimen has been identified by Mr. J. Lewis Bonhote, to whom I owe the information.

ear. The eyes are small, and nearly concealed by the long coarse hair of the face. On the lip there is a decided moustache of long hair, which rather incorrectly gives the name of "whiskered" bat. It should rather be called "moustached." The tip of the tail, which projects beyond the membrane, is slightly curved. The membrane of the wings takes its rise from the base of the fifth toe, and there is no lobe of the interfemoral membrane outside the calcaneum, which last terminates in a small projecting tooth. The fur is long and thick, and the hair on the upper part is dusky black colour over the greater part of its length, but bright chestnut at the tip. The tips of the black hair on the stomach are ash-gray. The ears and the flying membrane are nearly black,[1] and the transverse lines on the flying membrane are very numerous. The Whiskered Bat produces its young in the summer (end of June or beginning of July). It is rather a solitary creature, being very often found singly in its place of rest, though congregating in small numbers during the breeding season or when searching for food. This bat occasionally appears in the daytime, and does not seem to be as averse to daylight as others of its kind. Its hiding-place is generally in walls, roofs, and any convenient cranny in a building or in timber. Apart from the refuges offered by man, it is probably a cavern-haunter, in contradistinction to bats which make their home in hollow trees. It frequently flies low over the surface of the water, like Daubenton's bat. Its occurrence in England has been noted in the eastern counties and the Midlands, from Kent to the Lake District, and from the Isle of Wight to Norfolk. It appears to be quite absent from Scotland, but is somewhat doubtfully to be met with in the west of Ireland.



HEAD OF WHISKERED BAT
(2½ times natural size).

[1] In some specimens a well-defined pure black spot appears on each shoulder.

Myotis emarginatus. The Notch-eared Bat

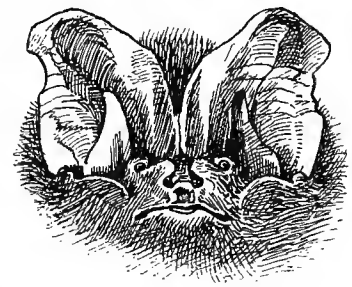
This is of very doubtful existence as a British species. It is a valid species, allied to *Myotis bechsteini*, and was first described by Geoffroy in France in the early part of the nineteenth century from specimens taken at Abbeville and at Dover. But the Dover specimen was subsequently shown to be *Myotis* (*Vespertilio*) *mystacinus*, a bat with which *M. emarginatus* is constantly confounded. Other reputed British examples of *M. emarginatus* have turned out to be *M. dasycneme* and *M. daubentoni*. But inasmuch as *M. emarginatus* is fairly common in Northern France and Belgium (elsewhere in Middle and Southern Europe and Western Asia), it is most likely to prove a visitant to Southern England. It is a small bat, head and body scarcely more than $1\frac{3}{4}$ in. long, tail nearly $1\frac{3}{4}$ in. in addition. The ears are strongly notched on the outer margin. Colour of fur is reddish-brown above and pale brown below. Skin of ears and wings reddish-brown.

Ear of Notch-eared Bat (*Myotis emarginatus*). Twice natural size.

Genus: *BARBASTELLA*

The two species of bat of this genus differ markedly from those already described, in that the ears, instead of being set somewhat widely apart, have their inner margins so approximated that they are actually united at their bases. The outer margin of the ear is carried forward in front of the eyes, and terminates near the upper lip, so that the whole of the face is very nearly enclosed in a circular band of ear cartilage. The inner margin of the ear is very convex and rolled backward. The membrane of both ears unites at their base. The tragus is nearly triangular in shape, with a curved, sharp tip. The eyes are small, and are situated close to the termination of the outer margin of the ear. The muzzle is very short, and is naked. The naked, grooved hollow along the nose is certainly peculiar, and suggests a

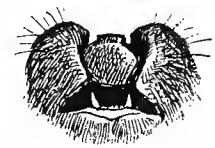
commencement of those conditions which invest so many bats with growths of cartilage above and around the nostrils. The nostrils open upwards in this groove, and the naked space extends along the bridge of the nose. Below the nostrils are a couple of deep vertical grooves extending to the lip, the space between these grooves being swollen. The cheeks are distended, and are covered with black hair. The length of these bats is about 2 in. from the nose to the base of the tail, and the tail is about $1\frac{3}{4}$ in. long. The teeth differ in number from those of the genus *Myotis* in the loss of a pair of premolars in each jaw, the total number of grinding teeth, therefore, being only five pairs in each jaw, instead of six. Of the two pairs of upper incisors, the innermost pair is much longer than the outermost. The outermost incisors are small, simple, and sharp-pointed. The innermost incisors are divided into two cusps. The feet are slender, with long toes.



HEAD OF BARBASTELLE BAT (*Barbastella barbastellus*). Note ear membranes joining over forehead, groove along nose and eyes fairly close together. Twice natural size.

Barbastella barbastellus. THE BARBASTELLE BAT

The description of the genus may be applied to this species, about which it may be said additionally that the fur is soft and deep black, with a grayish tinge on the surface caused by the tips of the hairs being that colour. The region round the genital organs is of a whitish-brown colour, and fine hairs of grayish-white grow sparsely on each side of the flying membrane, the skin of which is dusky black in colour. This is also the tint of the naked skin on the face, so that in average aspect the Barbastelle is the blackest of British bats. A perfectly white specimen of the barbastelle, and another in which the body was black, while the head and membrane were pure white, were seen and noted



NOSE AND MUZZLE OF BARBASTELLE BAT (3 times life size).

by the late Mr. Bell, who also records an extraordinary specimen that was caught in Warwickshire which had the fur of the under parts strangely tinged with purplish-red.[1] The barbastelle hibernates early, and appears to be very sensitive to cold. It does not frequent trees, but, on the contrary, seeks out deep caverns or profound crevices below the surface of the ground. It is said seldom to retire to the same place day after day, but to choose constantly a different retreat. It is a solitary bat, and its flight seems desultory and lazy. It also flies low.

Its distribution over England is not uniform. It is met with in Kent occasionally, in the midland counties, and in East Anglia. Examples have been captured as far west as Warwickshire, and as far north as Cumberland. It has never been obtained from Scotland or Ireland.

Genus: *PLECOTUS*

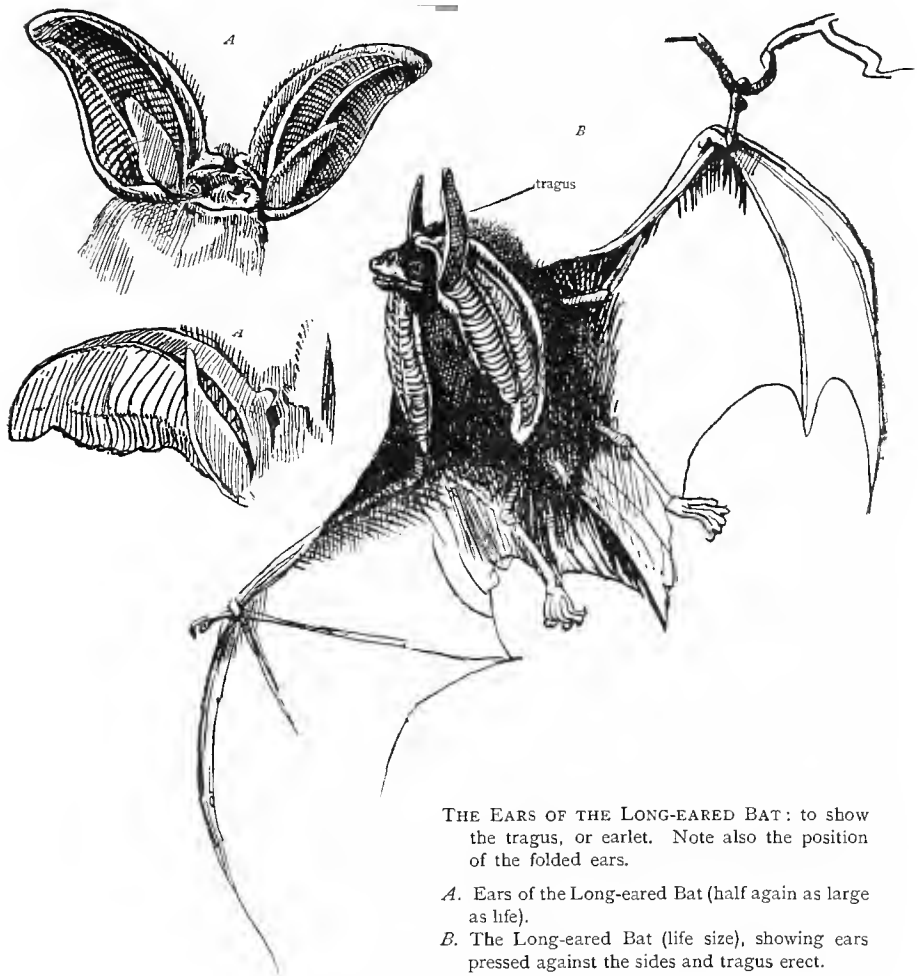
This is a genus represented by two species, one inhabiting North America and the other Europe, Asia, and North Africa. It can be best described in connection with the species that is found in Britain.

Plecotus auritus. The Long-eared Bat

This bat is readily distinguished by the enormous size of its ears, which are proportionately longer than in any other mammal. Each ear, in fact, is nearly as long as the animal's body. The Long-eared Bat measures a little under 2 in. from the tip of the nose to the base of the tail, and the tail is about $1\frac{3}{4}$ in. The ears measure in length $1\frac{1}{2}$ in., and in breadth three-quarters of an inch. The tragus is shaped rather like a leaf, except that the inner side is nearly straight. It is little more than half an inch long, and bends slightly upwards. The outer margin of the ear commences behind the angle of the mouth. The inner margins of

[1] In some other Vespertilionid bats there is a tendency in the breeding season for the males to develop a rich yellow tinge in the lower half of the hair of the under parts. It may be the same tendency which tinged the fur of this example with a purplish tone.

the ears are nearly joined at the base by a prominent rounded lobe. The inner portion of the ear conch is supported by three thin, slender, longitudinal cartilages. These cartilages serve to erect



THE EARS OF THE LONG-EARED BAT: to show the tragus, or earlet. Note also the position of the folded ears.

A. Ears of the Long-eared Bat (half again as large as life).

B. The Long-eared Bat (life size), showing ears pressed against the sides and tragus erect.

and stiffen the conch. The inner margin of the ear is covered with short hair, and is bent back from the middle cartilage into a broad longitudinal fold. The ears are very flexible, and quite under the control of the creature's muscles and tendons; they

are able to droop, and even to be turned under the arm during sleep. The ear conch is silky in surface and transparent, and can be thrown into elegant curves and folds. The eyes in this bat are well developed. They are placed not far from the corner of the mouth. The openings of the nostrils are at the extremity of the muzzle on the upper surface, in front of rather deep grooves, which are naked and nearly semicircular, and which are bordered by raised, rounded edges. The hair is long over the shoulders and thick, soft, and silky about all the body. It is a pale reddish-brown above and brownish-gray below, the basal part of the hairs being blackish. The flying membrane is blackish, with a slight red tinge. Old bats of this species tend to become rather gray in colour. As regards the teeth, the upper incisors are separated by a wide gap in the middle, and grow close to the canines. There are three pairs of incisors in the lower jaw as against two pairs in the upper jaw. The total number of the teeth is thirty-six. This is because there are three pairs of premolars in the lower jaw, as against only two pairs in the allied genus *Barbastella*. But for the loss of a pair of premolars in the upper jaw, the dental formula would be the same as in *Myotis*.

NOSE AND MUZZLE OF LONG-EARED BAT (3 times natural size).

This bat apparently brings forth its young in the month of June, a single one at a birth. It frequents for its retreat caverns, buildings, and hollow trees, especially affecting the inside of roofs of houses. In winter they pack themselves between the tiles, or in holes or crevices of timber. This bat rises readily from the ground, but crawls rather slowly and awkwardly over a flat surface, not being able to run quickly, for instance, like the pipistrelle. In the case of the long-eared bat the head and chest are raised, and the body is jerked forwardly from side to side. It moves the fore feet alternately, and endeavours to adhere to the slightest roughness or point of vantage into which it can stick the claws of its thumbs or toes. When walking it generally turns the great ear right back along the sides, while the tragus, or earlet, falls forward, so that very often in this attitude

the tragus appears to be the real ear. The ears are also folded under the arm during sleep and hibernation. Sometimes when this bat hovers like a humming-bird over foliage, picking off moths and caterpillars and other insects, the ears are bent outwards and downwards, so that they hang down on either side of the face like huge cheek pouches. When, however, the animal is flying from place to place the ears are erected. When preparing for repose the tail is curved in under the body. Undoubtedly these huge ears are extremely sensitive, not only to sounds, but to currents of air, and almost take the place of sight by the fine perception they give the creature of its approach towards an obstacle. Experiments made many years ago in France by a zoologist who blinded these bats, showed that they were but little embarrassed in their movements by the loss of sight. But when in addition their ears were closed the creature became perfectly helpless, and banged itself against obstacles.

This bat is more nocturnal than most species of the Vespertilionine and Myotidine sub-families, apparently remaining abroad all through the night, though it may also be seen hawking insects in the early twilight. Its voice is sometimes extremely shrill, so much so that some ears are incapable of distinguishing its squeaks, while others hear them distinctly above other sounds. Bell writes: "At all hours through the dead of the night and on the darkest nights, in the open fields or elsewhere, we have heard the shrill clatter of the long-eared bat over our heads; its voice, once known, being easily recognised from that of any other species." When actually interfered with the cry becomes clear and piercing.

The long-eared bat is a cleanly creature, assiduously removing impurities from its fur at all times, and even assisting its comrades to do so. They are affectionate one towards another, though spiteful to other bats of different species, and very playful. Their tameness in captivity, according to the accounts given by Bell, is perfectly charming. They would fly to the hand of any one who held up an insect, or even take with great gentleness a little piece of raw meat from between the lips. If

any one made a humming noise like a bluebottle, the bat would fly up to his face and search his lips anxiously. As this creature, in common with other English bats, does absolutely nothing but good in ridding the country of noxious insects, it is to be hoped that it will henceforth receive protection at our hands ; for, in addition to rendering such beneficial services, it is one of the most remarkable objects in Creation, having so far uttered "the last word" on the subject of ear development.[1] This wonderful little bat is distributed throughout Europe, Temperate Asia, and Africa north of the tropics. A closely allied species is found in North America. Its distribution in the British Islands is encouraging (in view of the extreme scarcity of other bats). It ranges over England, Ireland, and Scotland, though it may be absent from the Hebrides and Shetland Islands.

FAMILY: *RHINOLOPHIDÆ*. THE LEAF-NOSED BATS

The bats of this family develop more or less extraordinary appendages round the nasal apertures. There is a tendency in most bats to large nostrils, and to grooved and naked spaces above and below these apertures ; and, indeed, in two genera of *Vespertilionidæ* allied to *Plecotus* (*Anthrozous* and *Nyctophilus*) there is a rudimentary nose leaf. A somewhat similar development takes place in the rather distinct family *Phyllostomatidæ*, which includes the vampires. But nothing in this last-named family equals the extravagant development of nose leaf to be seen in some of the Rhinolophids. The ears are also remarkable in that, though large, they are without any tragus, or earlet, the place of which is almost filled by a remarkable lobe developed from the outer margin of the ear. The pre-maxillary bones are reduced to rudiments suspended from the nose cartilage, and supporting one pair of small incisors. There are never more than two pairs of incisors below and one pair above, and the

[1] Bell very rightly insists on this wonder, which only escapes our notice because the creature that exhibits it is so small. He asks us what we should think of a dog or an ass the ears of which were nearly as long as its body.

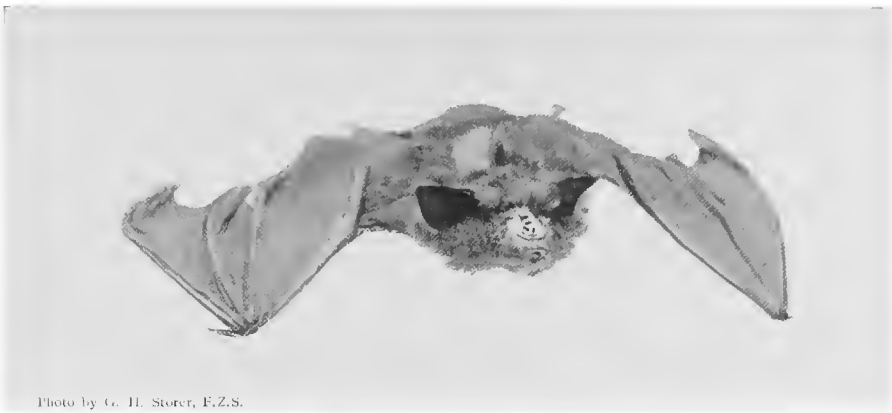


Photo by G. H. Storer, F.Z.S.

GREATER HORSESHOE BAT (*Rhinolophus ferrum-equinum*).

Photo by C. Reid.

COMMON BAT (*Pipistrellus pipistrellus*).

To face p. 108.

upper premolars are reduced to two pairs. The skull is large, and the nasal bones supporting the nose leaf are expanded vertically or laterally. The nose leaf varies slightly in dimensions between the male and the female, and is less developed in some forms than in others. The tail is not very long, and is entirely enclosed within the interfemoral membrane.

The late Sir William Flower regarded the Rhinolophids as the most highly organised and eleborately developed of the insectivorous bats.

GENUS: *RHINOLOPHUS.* THE HORSESHOE BATS

The dental formula is as follows:—In the upper jaw, one pair of rudimentary incisors, one pair of canines, two pairs of premolars, and three pairs of molars; in the lower jaw, two pairs of incisors, one pair of canines, three pairs of premolars, and three pairs of molars. The molar teeth are armed with sharp cusps ranged in the shape of a W (as in a good many other forms of insectivorous bats).

HEAD OF GREATER HORSESHOE BAT (*Rhinolophus ferrum-equinum*): to show nose leaf. Note also absence of tragus and large development of lobe of outer margin of ear. Nearly twice natural size.

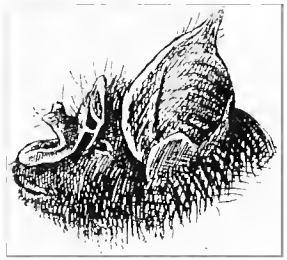
The first hind toe, or hallux, has only two phalanges. Each of the other toes has three. Although there is no true tragus, or earlet, its place is taken by an antitragus, which is a development of the outer margin of the ear, and from which it is separated by a notch.

Rhinolophus ferrum-equinum. THE GREATER HORSESHOE BAT

This creature, though not so remarkable in its development of nasal cartilage as the genus *Triænops*, has nevertheless a sufficiently extraordinary appendage to its nostrils. The nose leaf consists of three portions. That which lies immediately above the lip

(the lip is hairy and cloven) is horizontal, and shaped like a horseshoe. This is divided in the middle by the same septum as cleaves the upper lip. Behind the horseshoe is a deep depression, in which the nostrils are situated. Between the nostrils, from the septum of the nose, rises the second portion of the leaf. This presents a cup-like hollow, where it rises from the septum of the nose, and then, after a contraction and expansion, ends in a sharp point which is raised above the third section of the leaf. This last lies under the horseshoe at its base, and is of the same breadth, but narrows and finally tapers to a point on the forehead.

Undoubtedly one use of the nose leaf is to act as a receiver of sensations and enable the bat to thread its way through the most intricate passages without using its small and inconspicuous eyes. A horseshoe bat turned loose in a room, for instance, will, unlike most other bats under similar conditions, avoid with perfect ease every kind of object, without ever coming into direct contact with anything. But the nose leaf is also due to that craving for the development of ornament common to most animals. Bats of the family *Phyllostomatidæ* decorate not only their noses, but also their under and upper lips.



NOSE LEAF OF GREATER HORSESHOE BAT IN PROFILE (slightly larger than natural size).

The ears of the Greater Horseshoe Bat are rather large, and broad at the base. The inner margin is much curved, and ends in a sharp point, which is a good deal turned outwards. The conch of the ear is marked by about twelve transverse ridges. On the outside of the ear conches grows a little fine hair, which becomes a thick fringe of fur along the inner margin. The forehead and cheeks are thickly clothed with hair, and the eyes are small and nearly hidden between the hair of the forehead and the cheeks, and the large raised nose leaf. The head and body of this bat measure a little over $2\frac{1}{4}$ in. in length. The tail is about $1\frac{3}{8}$ in.

The colour of the great horseshoe bat above is reddish-gray, the fur being paler at the root than at the tip. The belly and under parts of the body are very pale gray. The cartilage of the ears and of the nose leaf is pale brownish flesh-colour, and the flying membrane is dark grayish-brown.

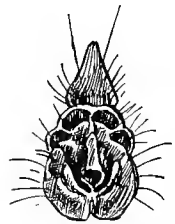
The female of this and other Rhinolophids exhibits a pair of warts on the skin of the abdomen which correspond internally to the front of the pubic bones. These warts have been taken by some to represent a disused pair of inguinal mammæ which are no longer functional.

The horseshoe bats fly high when hunting for insects, and live a good deal on cockchafers. The wings are broad, and in flight this bat may be told from other species by the greater width of the flying membrane. The horseshoe bat appears rather late in the evening, and affects the neighbourhood of trees, flying round and round the foliage to snap up beetles and other insects of good size. When it retires, however, to rest during the day or to hibernate, its favourite haunts are ancient buildings and caves. It is estimated that it has continued to inhabit the large cave known as Kent's Hole, near Torquay, continuously since the age of the mammoth. In this cave its remains are found going back to the Pleistocene period. Its present distribution in these islands is confined to the south and west of England. It ranges from Devonshire and Gloucester to the Isle of Wight, Kent, and Essex, and is occasionally met with in the Midlands. Hitherto it has been entirely unknown in Northern England, Scotland, and Ireland. Outside England the greater horseshoe bat extends its range over most parts of Europe and Africa, and of Asia north of the Himalayas.

Rhinolophus hipposiderus. THE LESSER HORSESHOE BAT

This is a smaller animal than the previous species. It measures a trifle over 1½ in. for the head and body, and just over an inch for the tail. The measurement across the wings in the larger specimens is 9 in. The teeth are the same in number as the greater horseshoe bat, but the first premolar in the upper

jaw is extremely minute. The ears are still more pointed, and the outer margin is deeply notched and almost separated from the large antitragus, which is really a fold of the outer margin of the conch. The nose leaf is proportionately smaller than in the greater horseshoe bat. The first, or "horseshoe," portion is less closely applied to the upper lip than in *Rhinolophus ferrum-equinum*, and its lower edge is slightly crimped. The erect process between the nostrils is proportionately shorter, and is much less cupped at the base. The posterior portion which grows over the forehead is shaped like the head of a lance, and is of greater relative size than in the preceding species. The muzzle is a little less swollen than in the greater horseshoe bat, and the colour of the fur a little yellower below, and rather more brownish-gray than reddish-gray above.



NOSE LEAF OF LESSER HORSESHOE BAT (*Rhinolophus hipposiderus*) (twice natural size).

The Lesser Horseshoe Bat is equally clever in its ability to maintain itself on the wing in the most cramped and intricate quarters without coming into contact with obstacles. It will enter quite small crevices on its flight and emerge again, and apparently never touch any place with the wings. When pausing before any object which it wishes to inspect it keeps up a vibratory motion of the wings like a humming-bird. It is quite well able to use its eyes (though these are very small, and almost hidden in the nasal cartilage), but in all its flights and researches it seems to trust to the sensitiveness of the nose organ, of the ears, and of the wing membrane to guide its movements. The distribution of this bat is nearly as extensive as (but not quite identical with) that of the bigger form. It is found pretty widely over the southern half of England. It is also met with in Western Ireland. No specimens have yet been sent from the north of England and Ireland, from Wales, or from Scotland. Outside these islands it extends over Central Europe as far north as the Baltic and the more northern regions of Russia. It is found, no doubt, over the greater part of Temperate Asia, and has

been obtained from the regions of the Himalayas and North-west India. It is also distributed over Northern and North-east Africa as far south as the Sahara Desert and Nubia. Species allied to the horseshoe bat range over India, Malaysia, and Northern Australia, and over Africa as far south as the Cape.

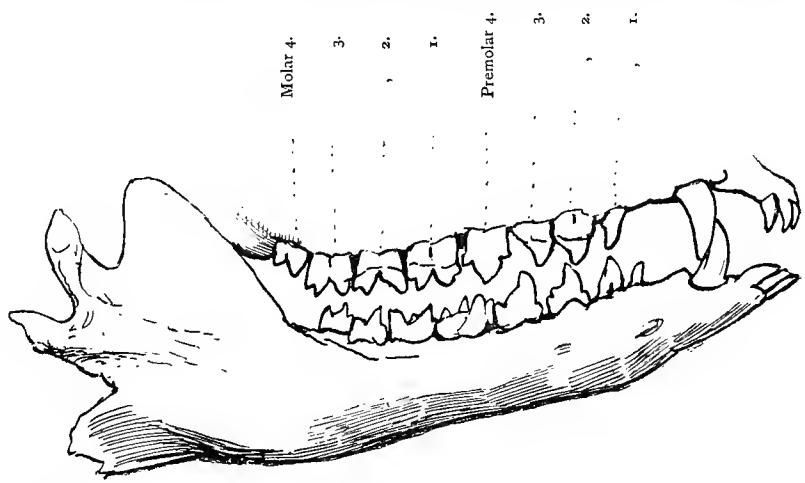
It will be seen from the perusal of the foregoing chapter that our knowledge of British bats is relatively scanty, and requires much additional research, not only into the life history of these interesting creatures, but still more into the identification and correct naming of British species. At least four of the species here enumerated and described (*Vespertilio murinus* or *discolor*, *Myotis dasycneme*, *M. bechsteini*, *M. myotis*) are so rare as British examples that they are often refused admittance into lists of British mammals, and their few undisputed occurrences are attributed to accidents or the result of high winds. Seeing the flying powers of bats, and the ability of some species at least to swim if thrown into water, the twenty to sixty miles of sea between France and Belgium on the one hand and England on the other ought not to deter the bats of Continental Europe from colonising Britain. Assiduous efforts, therefore, should be made to collect and identify bats throughout Great Britain and Ireland.

CHAPTER VI

ORDER : *CARNIVORA.* THE FLESH-EATING PREDATORY MAMMALS

DOGS AND BEARS

THE True Carnivora arose from or near to a group which we know as the Creodonta, and which flourished early in mammalian history. The Creodonts first make their appearance in strata of the Lowest Eocene—that is to say, at the very commencement

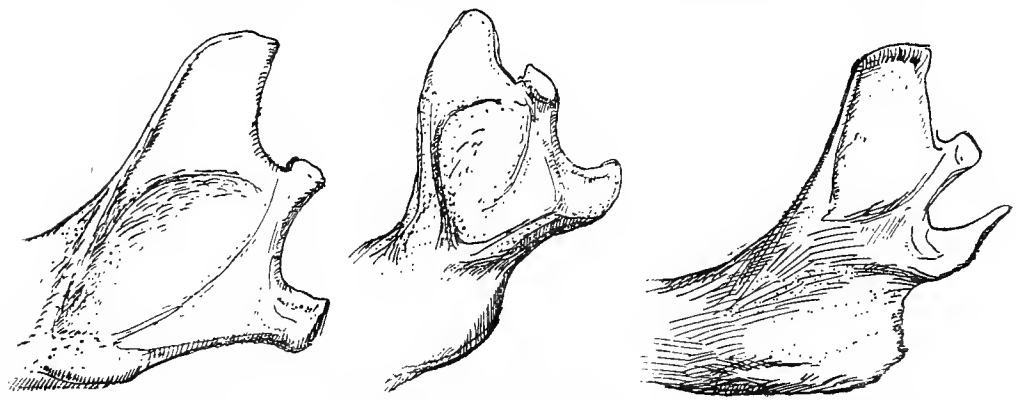


JAWS OF *Otocyon megalotis.*
Slightly separated, to show molar teeth (four premolars and four molars in both jaws) and absence of differentiation in the carnassial teeth (fourth upper premolar and first lower molar).

of the Tertiary Epoch. Their earliest types were generalised, and betray considerable affinities to the Marsupial order. They almost represent, indeed, at that period the main line of mammalian descent, the arrangement and aspect of their teeth

not only closely resembling existing carnivorous Marsupials, but even the dentition of the Theriodont reptiles. There were in each jaw at least three pairs of incisors, one pair of tusk-like canines, four pairs of premolars, and three of molars: the typical mammalian formula of forty-four teeth.[1]

Modern Carnivora are divided into two sub-orders: the *Fissipedia*, or separate-toed flesh-eaters (dogs, cats, civets, weasels, bears); and the *Pinnipedia*, or web-toed fish-eaters (sea-lions,



Angle of lower jaw of Wolf.

Angle of lower jaw of *Canis cancrivorus* (Crab-eating Dog of Central and South America).

Angle of lower jaw of *Otocyon megalotis*.

ANGLE OF THE LOWER JAW IN *Otocyon*, AS COMPARED WITH THE ANGLE OF THE JAW IN *Canis cancrivorus* (CRAB-EATING DOG) AND IN WOLF.

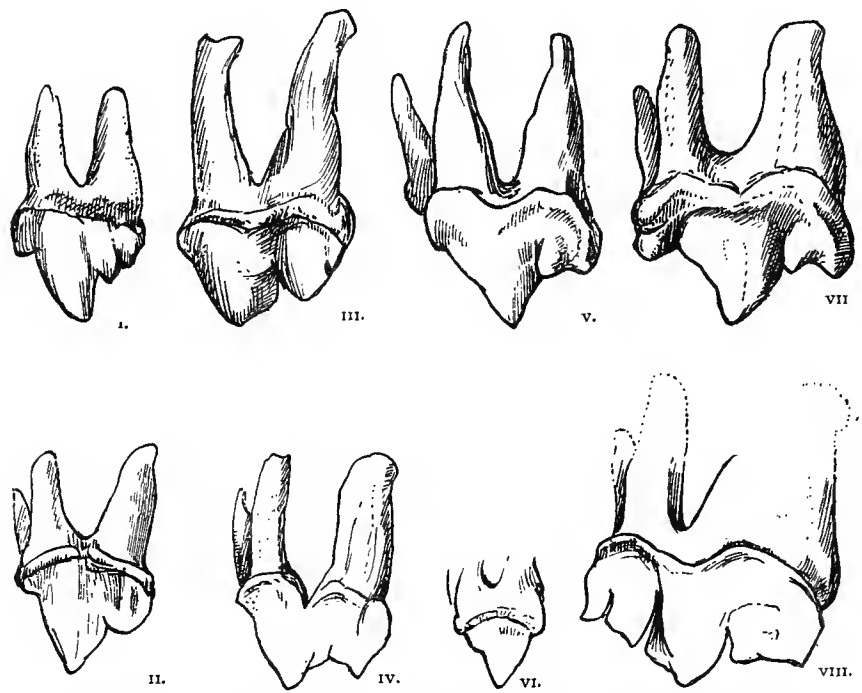
[1] So far as I am aware no Creodont (unless it is so with *Proviverra*) has ever been discovered which possessed more than three true molars, and yet there is one remarkable problem in the descent of the Carnivores which has not yet been solved. In South and East Africa is found a curious aberrant dog, called the long-eared fox (*Otocyon megalotis*). This creature has four pairs of molars in the lower jaw, and very often four in the upper. A fourth molar makes its appearance in the lower jaw of dogs of the genus *Canis* occasionally, and an increase of molars to four or more appears as a common feature in existing or extinct Marsupials. On the other hand, no existing Marsupial has more than *three* permanent *premolars*. One of these teeth, however, is preceded by a "milk" premolar, which may be the missing fourth of this series of teeth. In extinct mammals that are supposed to have been Marsupials, four premolars are present. On the other hand, in these extinct Marsupials with four premolars, there would appear to be only three molars. It would almost

walruses, seals). Besides the special adaptation to a life in the water which affects the *Pinnipedia*, there is a further marked difference between them and the terrestrial Carnivores at the present day. The *Fissipedia* have developed a pair of carnassial or powerful cutting teeth from out of the grinders in both jaws. In the upper jaw this carnassial tooth is the fourth premolar. In the lower jaw it is the first true molar. Now in the seals there is no special differentiation, for crushing or tearing purposes, of either the premolars or molars. This feature of the carnassial teeth, however, is scarcely developed at all in *Otocyon*, and but little developed in aberrant forms of the Raccoon family and in the Bears.

The Carnivora are for the most part five-toed, and never have less than four toes on each foot. Their teeth are always rooted. The incisors are almost invariably three pairs in each jaw, except in the case of the seals. The molar and premolar teeth are generally narrow, and divided longitudinally into sharp cusps ; but if broad, flat, and set with tubercles, they are never

seem, therefore, as though, to account for the four molars of certain dogs co-existing with four premolars, we must go back for the origin of the modern Carnivora to a proto-mammalian type ancestral to Marsupials, Creodonts, and other mammalia. Until some Creodont is discovered with four molars, it will be difficult to believe that the existing Carnivora have descended from that group. The Creodonts, like the carnivorous Marsupials, probably pursued a parallel line of development as predatory flesh-eating mammals. It might, perhaps, assist the reader of these pages who is not well acquainted with the nature of teeth, to be told that the distinction between molars and premolars is this. Premolars have—at any rate for the last three of the series—"milk" predecessors in most mammals, whereas true molar teeth have *no* predecessors. This distinction scarcely applies to some teeth in Marsupials, whose "milk" dentition has been almost suppressed. Molars and premolars, therefore, in those creatures are generally distinguished by shape ; but, even in this case, what is equivalent to the fourth premolar in a Marsupial has a "milk" predecessor. As regards the fourth true molar tooth, it is found in some Edentates, living and extinct ; in extinct Sirenians (ancestors of the dugong and manati) ; and perhaps occurred in the earliest Primates. It makes its appearance even in the human species occasionally, and as a sport this happens much more frequently in the black Australian and the Negro races than with Europeans.

divided up into complex lobes marked by deep inflections of enamel (like the zigzag ridges so often met with in Rodents and Ungulates). The stomach is always a simple pear-shaped bag, and the cæcum is either absent or short and simple in most (but not all) cases. The mammæ vary in number from one pair to six pairs. The clavicle, or collar bone, is frequently absent,



THE UPPER CARNASSIAL TOOTH (FOURTH PREMOLAR) IN VARIOUS CARNIVORES.

I. In Common Seal (*Phoca vitulina*), two-rooted.
II. In an extinct Creodont of the Eocene period (*Proviverra*), three-rooted.
III. In Bear (*Ursus arctus*), two-rooted.
IV. In Glutton (*Gulo* of the Weasel group), three-rooted.
V. In the Wolf (*Canis lupus*), three-rooted. Very similar in all other existing members of the genus *Canis*.
VI. In *Otocyon* (the Long-eared Fox).
VII. In Lion.
VIII. In a Machairodont (*Machairodus neogæus*).

and, if present, is in a rudimentary condition and incomplete. There are other marked features in the bones of the limbs which are characteristic of this group, but which it is not necessary to describe here. In the True Carnivores, or *Fissipedia*, the first

finger of the fore limb (our thumb) is always shorter than the others; and this is generally the case with the first or innermost toe in the feet.

FAMILY: *CANIDÆ*. THE DOGS

In some respects this group is the most generalised of the existing Carnivora. In one genus (*Otocyon*)[1] (and occasionally, as a sport, in the genus *Canis*) the number of teeth reaches to or exceeds the typical mammalian forty-four because it includes one or two extra pairs of molars. The cæcum is always present, in some species short, in others long, and rather curiously folded. There is an alisphenoid canal,[2] but the entipicondylar perforation of the humerus (see p. 149) is wanting in existing dogs, though present in extinct forms. No known dog is ever marked with spots and stripes, as in the cats, civets, and some other Carnivora; but there is a slight tendency to black-and-white markings on the face, characteristic also of the raccoons and badgers.

GENUS: *LYCAON*. THE HUNTING DOG

This genus is scarcely separable from that which follows; but in *Lycaon* there are only four toes on each limb, as against five on the fore feet and four visible toes on the hind limbs in the typical dogs. The teeth of *Lycaon* are more massive than those of the wolves. The fourth premolar in the lower jaw has an extra cusp in front. The skull is somewhat shorter and broader. The Hunting Dog is also distinguished by the relative length of the intestines, and by the cartilage below the tongue. The ears are long and somewhat rounded, and the tail is bushy. The coloration is very peculiar. On a groundwork

[1] It is really a question whether *Otocyon* should still be included in the family *Canidæ*. Its osteological differences from the True Dogs are at least of family rank.

[2] The alisphenoid canal, constantly referred to in the classification of the Carnivora, is a short channel or tunnel in the alisphenoid bone, on the under surface of the skull, near the origin of the palate. Through this perforation passes the carotid artery.

of ochre and grey are scattered large tracts of blackish fur, which on the stomach and thighs break up into spots. These black blotches also extend over the limbs and the base of the tail. The genus *Lycaon* presents one archaic feature marking it off from other existing dogs: it has considerable traces of the collar-bone, which in the modern representatives of the dog tribe is reduced to a mere cartilaginous rudiment. In many respects, however, the genus approximates closely to the Lupine group of true dogs. The present range of the genus is confined to Africa, south of the Sahara, chiefly to Eastern and Southern Africa; but a jaw bone, resembling that of the *Lycaon* in the peculiar last lower premolar, was found in a cave deposit in Glamorganshire, and therefore seemed to show the existence of a hypothetical *Lycaon anglicus* in Wales and probably in England during the Pleistocene period.

Genus: *CANIS*. THE TRUE DOGS

The dental formula of this genus is normally three pairs of incisors, one pair of canines, four pairs of premolars, and two pairs of molars in the upper jaw, the same number of canines, incisors, and premolars in the lower jaw, but generally three, or abnormally four, molars in the lower jaw. One group of dogs, the sub-genus *Cuon*, has lost the third molar in the lower jaw. On the other hand, an American dog (*Canis cancrivorus*) sometimes has three pairs of molars in the upper jaw. The fourth premolar, or upper carnassial tooth, consists of a stout cutting blade with a scarcely developed anterior lobe (differing thereby from the cats), and a compressed ridge forming the posterior lobe. The tooth which meets this in the lower jaw is the first molar, which is a very large tooth with a strong compressed blade divided into two lobes, the hinder of which is the larger and more pointed. The remainder of the tooth is broad, low, and tuberculated. The collar bones are very rudimentary, represented by little else than cartilage. There are five toes on the fore feet, the first, or thumb, being very short and at some distance from the ground. Although there are only four toes visible in the

skin of the hind foot, there is a rudiment of the first toe in the bones of the metatarsus.

The dogs of the genus *Canis* might be divided into these groups: the Fox, or Alopecoid division; the Wolf, or Lupine section, which in the main includes the races that have formed the domestic dogs; and the Cyonines, or East Asiatic wild dogs of the sub-genus *Cuon*; besides several aberrant forms in sections by themselves. The Fox group, perhaps, is a little less specialised than the other three divisions. In England it has been represented since the Pliocene period; and perhaps in the Glacial ages the Arctic fox (*Canis lagopus*) dwelt in these islands, and, at the same time, penetrated far south into France. But the remains of this animal in England are so scanty and doubtful that it is hardly worth while including it in a description of the British mammalian fauna.

Canis vulpes. The Common Fox

The fox differs from the dogs of the Wolf group in the absence of air cells in the forehead of the skull, as well as in the shape of the hinder portion of the bone of the eye socket, the upper surface of which is concave instead of convex. In general it is more slender in the build of its body and has shorter limbs. The tail in the Common Fox is nearly half the length of the head and body. The length of the head and body in an average dog fox is about 3 ft., and the tail about 1 ft. 3 in. Specimens of English foxes have measured as much as 3 ft. 10 in. from the tip of the nose to the base of the tail. The ears are large, and the pupil of the eye, instead of contracting under a strong light into a round spot, as in the dog or the wolf, forms in the fox a slit or ellipse. The number of teats also is different, being six, as against eight or ten in the wolves and dogs. The muzzle is brought to a sharp point in the nose, and this pointed aspect is added to by a considerable projection of the nose and upper lip beyond the lower jaw. The vibrissæ, or "whiskers," are very abundant.

Foxes, also, are not only more nocturnal in their active life,

Photo by C. Reid.

THE COMMON FOX (*Canis vulpes*).

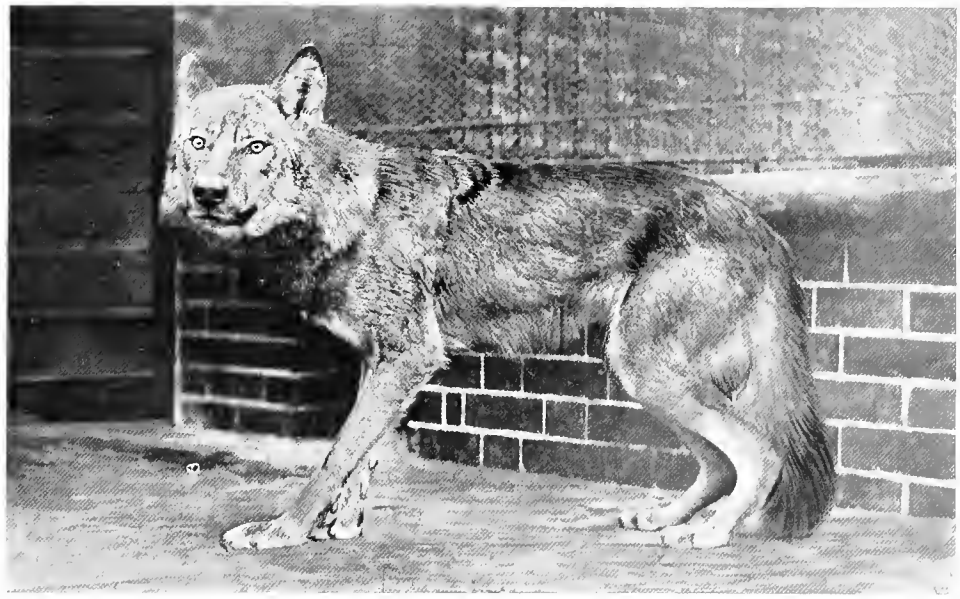


Photo by the Scholastic Photo Company.

THE WOLF, EUROPEAN TYPE (*Canis lupus*).

To face p. 120.

and more given to burrowing and inhabiting burrows than wolves or dogs, but they are in comparison solitary in their habits, and do not associate so much in packs. In this respect the Arctic fox above alluded to is perhaps a little more dog-like, as it generally dwells in small colonies of from twenty to thirty burrows each.

The colour of the common fox varies slightly in different districts of Great Britain and abroad, being somewhat grayer in Scotland than in England. The following, however, is a fairly accurate description of the coloration of the English fox in winter and summer alike. The lower portion of the cheeks and the under part of the throat, neck, and chest, and the upper and lower lips, are white. The belly is dirty white, with a tendency to become brown in some examples, or actually grayish-black in others. The inside of the thighs and of the arms from the elbows to below the wrists is white, and there is a marked white line extending down the outer aspect of the hind legs from the knee to near the inside of the hock. The long hair inside the ears is yellowish-white. The front part of the upper lip and the muzzle round the nose is blackish-brown, and a blackish line separates the white of the upper lip from the red of the nose, and is then continued in a narrow but distinct line to the inner angle of the eye. The centre of the nose is also inclined to be blackish-brown. The outer side of the large ears is black or blackish-brown, the black being very evident along the inner edge. The feet are black, with sometimes a patch of white on the inside of the fore paws, the inner side of the feet being brownish, while the black of the outer aspect is often continued up the edge of the arm to the elbow. The long vibrissæ are black, and the long hairs along the back and sides of the tail are often tipped with black. The hairs of the soles of the feet (unlike those of the dog and the wolf, the soles are hairy and not naked) is deep red. The whole remainder of the coloration not as yet described varies from a beautiful orange-red to an almost silvery pinkish-gray. The forehead, the region round the eyes, and the upper part of the nose, the shoulders, and arms are particularly bright orange-

red, and this tint also prevails on the outer aspect of the thigh and leg. The long fur on the flanks and hind quarters is a silvery reddish-brown, because many of the hairs are whitish towards their extremities. The greater part of the tail is brown or yellowish-brown, mingled, as above stated, with black or white-tipped hairs, the black hairs being very numerous along the sides of the tail. The general aspect of a fox, then, is red-brown above and outwardly, and white below and inwardly, with black ears, a blackish muzzle, and a black-fringed, white-tipped tail. The short nails on the feet are horn-colour. In coloration the fox is almost the handsomest of our British beasts. In Scottish types there is more gray, especially about the hair on the upper parts, and a greater proportion of white hairs on the hind quarters, while the white tip at the end of the tail is larger. About the Cheviots and the Scottish borderland the foxes are smaller, the fur is a darker red, and the tip of the tail has little or no white. In Wales, according to Mr. W. E. de Winton, a blackish-brown type of fox is sometimes met with, but in South Wales the present writer has noticed the particularly orange colour of the fox's fur. The occasional specimens with blackish-gray bellies that are met with in England recall the variety of the common fox which is more characteristic of Southern Europe and Northern India. There is a great tendency in foxes to abrupt alternations between a blackish and a white belly,[1] and this tendency to alteration in tint may have made itself felt independently in England. On the other hand, it is possible that the dark-bellied examples met with in this country may be due to the importation of foreign foxes, which have so often been brought over to reinforce the native breed ever since the fox became a fashionable contributor to sport. Female foxes do not differ in colour from the male, though they are smaller in size. Fox cubs, however, are decidedly different from their parents in coloration. There is scarcely any black or white about them, and the general colour is a brownish or pinkish-gray, not unlike the colour of the coat

[1] The white tip to the tail, so characteristic of *Canis vulpes* in all its varieties, may also appear as dark gray or even black in English specimens.

assumed in summer by the Arctic foxes. This tint soon warms into yellowish-brown, and by the time the fox is a year old has it developed the colours given in the foregoing description.

The fox, like some other species of dogs, possesses a scent gland, which is situated under the tail, near the anus, and which secretes a fœtid sebaceous substance. This gland is present in both sexes, but is a little more highly developed in the male. The urine of the fox has the same strong and unpleasant scent as the sub-caudal secretion. Glands, and nasty odours communicated to the excreta, are a constantly recurring feature in the Carnivora, reaching, perhaps, its highest point of development in the skunk, a member of the Weasel tribe. In civets the strong odour is agreeable to man, and not absolutely repellent, as is the case with foxes, cats, and many members of the Weasel family. This stench which attaches itself to the fox provides the means through which he is tracked by the dogs and hunted down.

No fossil remains of the fox have yet been obtained from Scotland. It is possible, therefore, that the fox may only have penetrated into North Britain since the close of the Glacial period, but its fossil remains have been found in some of the Irish caves, dating from the close of the Pleistocene. In England the creature is one of the oldest of British mammals, and dates from the Pliocene Epoch. In all probability it was here long before the advent of man, and at a time coeval with the sabre-toothed tiger and the huge fauna more characteristic of Eastern Asia and Equatorial Africa. At the present day the fox is found all over England, Scotland,[1] Wales, and Ireland. It has probably been affected to some extent by the introduction of foreign breeds from Sweden and Germany.

Another instance of the difference between the Fox group and the Wolf group of the genus *Canis* is that, whereas the domestic dog (which belongs to the Wolf group) will freely interbreed with the wolf or jackal, it generally regards the fox of either sex

[1] Not, however, including the Hebrides, Mull, and almost all the large islands off the west coast of Scotland, except Skye (where it is indigenous).

with detestation ; and although instances of interbreeding have been reported, they are extremely rare.

Foxes never consort in couples, male and female, except during the breeding season ; and even then as many as three dog foxes may be hanging round the vixen[1] to solicit her favours, rather than one chosen husband. The vixen only breeds once in the year, generally in February. She attracts the dog foxes by uttering a sharp bark. When the vixen is pregnant she leaves the society of the male and makes or takes a burrow for herself. Here the young are born, generally in the month of April, after a period of gestation of between sixty and sixty-five days. Foxes only breed once a year. The females only come into season once, and not twice, in the twelve months, as is the case with dogs. The number of cubs in a litter varies from three to seven. Fox puppies are born blind, and do not open their eyes until about the age of ten days. They are playful little creatures, and very active, with a yapping cry which is like a short bark. The mother suckles them about a month, and then brings them food, such as young rabbits, and later on she takes them out with her, and trains them to hunt for themselves, summoning them to the trail with sharp barks.

Compared to dogs and wolves the fox is a very silent animal. The usual cry is a short bark, not unlike that of the domestic dog. This is only uttered during the breeding season or when the female is calling to the cubs. It does not howl like the jackal or wolf.

The cunning and sagacity of the fox have become proverbial in European folklore.[2] This beast stands for astuteness

[1] A south-west dialect word, originally derived from the Anglo-Saxon *fuxen* = female fox. The word "fox" itself is an old term of the Teutonic branch of the Aryan languages which can be traced back to a form like the Gothic *fauho*, or *faukhs*.

[2] Reinaert (Reynard) de Vos (fox), an old Low German beast epic, summed up the impressions which the fox, the wolf (Isengrim), the badger, the bear, the hare, the sheep, the lion, and the monkey had made on the mind of European man from the close of the Glacial age to the close of the Roman Empire.

and unscrupulous cleverness, just as the wolf represents stupid ferocity. In some districts, however, where it has been long unmolested, its attacks on live stock in the vicinity of human habitations almost assume the boldness of a wolf. When the present writer was in Achill Island, in the autumn of 1902, the natives of that west-of-Ireland paradise complained to him of the boldness and audacity of the local foxes, which during the winter-time would descend the hillsides into the villages along the seashore, and take geese and fowls and young pigs from under the noses of their enraged proprietors. The same foxes are accused by the people in the summer-time of attacking young foals on the uplands, and killing many lambs.

It is almost a commonplace to point out that the fox is subterranean in his dwelling ordinarily. He either excavates burrows for himself, or appropriates those which have been made by the badger or the rabbit. At the bottom of these "earths" the fox remains concealed during the daytime, unless love or hunger should drive him abroad before dusk. But in the summer-time he frequently leaves the burrow in well-wooded districts and lies in the thick vegetation and undergrowth, making a sort of lair for himself. In favourable seasons, when there are young hares or young birds about, the fox frequents cornfields and hedgebanks, or it may even take up a dwelling in ricks or straw yards close to the farm building from which it intends to rob poultry.

The food of this predatory animal is most varied and comprehensive. It kills and eats hares, rabbits, pheasants, partridges, lambs (in the west of Ireland it is said to kill and eat the foals of mountain ponies), hedgehogs, rats, mice, voles, any bird which it can surprise and capture, frogs, the larger beetles, grubs, and worms. It will also, especially in Scotland, frequent the seashore and eat fish (fresh or putrid), shellfish, and crabs. It is ready to devour carrion of any kind when hungry, and, of course, delights in robbing hen roosts and carrying away ducks and geese. It will attack, kill, and devour swans; in fact, the present writer knows of a pretty mere in the New Forest from which all

the swans have been exterminated by foxes. With its rapacious instincts, the fox does a great deal of damage, not only amongst domestic birds and beasts which are the property of man, but amongst the wild creatures of the wood and the lake. Artificially protected as it has been since its pursuit on horseback became a favourite and well-established sport some two hundred years ago, the fox is no doubt answerable for a decided thinning of our indigenous birds and beasts.

During the rule of the Plantagenets foxes are mentioned, but somewhat contemptuously, as beasts of venery. Early engravings seem to indicate that the fox was pursued to his earth by a single hound followed by sportsmen on foot, who then proceeded to dig him out. It is probable that regular foxhounds, of French or Spanish[1] origin, were not kept in England till the latter half of the seventeenth century. About the beginning of the eighteenth century it became customary to follow the hounds on horseback. Hitherto mounted men had chiefly devoted themselves to the pursuit of deer. Fox-hunting at the end of the eighteenth century meant striking a fox's "drag," or scent, early in the morning, and following this drag till the hounds traced it to the kennel or earth to which the fox had retreated. In modern fox-hunting a man is sent to stop up all the "earths," or foxes' burrows, in the district over which hunting is to take place. To do this successfully he must commence operations soon after midnight, that is to say, after the foxes have left their holes to forage for food, and he must complete his work before the approach of morning, before they are back again in their burrows. Should he be too late at any particular earth he may stop the fox inside and completely spoil sport.

Supposing these directions to have been efficiently taken, one or more of the foxes in the district will have found himself shut

[1] This refers to the class of hound that would not only pursue, but, if necessary, grapple with and kill the fox. Much earlier in English history the dogs which tracked foxes to their burrows may have been of a smaller breed, and perhaps more of the terrier class. These, in fact, were known as "fox dogs."

out of his retreat, and must perforce lie concealed as best he can in the vicinity. Here he is put up by the hounds, and he then leads the hunt in the direction of some possible refuge, which he either succeeds in entering or which he fails to reach before the hounds despatch him.

Canis lupus. The Wolf

Between the Wolf and the Fox groups (the "Thooid" and "Alopecoid" of the genus *Canis*) there are some transitional forms of dog that it is difficult to allot definitely to either division. These are several South American dogs, and the raccoon-like dog of Japan and North-east Asia (which is remarkable for its extraordinary resemblance, especially in coloration, to the Raccoon family).[1] The Thooid, or Lupine, series includes the jackals, the Abyssinian wild dog, the wolves of Europe, Asia, and North America, and all the breeds of domestic dog. There is a third series of canine species which might be termed the Cyonoid, and it may be briefly mentioned here in connection with the origin of the domestic dog. The Cyonoids constitute the representatives of the genus or sub-genus *Cuon*, and are represented by a series of wild dogs stretching from Siberia on the north to the verge of Australia in the south. This sub-species *Cuon* was represented anciently in Europe[2] by a form which has been named *Canis* (*Cuon*) *europæus*. The dingo of Australia is closely related to this group, from which, indeed, may have sprung a considerable element in the stock of the domestic dog. The reason why these Cyonoids are separated from the Wolf group is that they often lose their third molar tooth in the lower jaw, though this loss is by no means constant. They also possess as a rule six pairs of teats, instead of five pairs which are customary in the wolf and in most dogs.[3] The profile of the face in some of them

[1] It is really, in all probability, only an aberrant fox.

[2] Possibly also in Southern England.

[3] Mr. A. J. Sewell, the well-known M.R.C.V.S., informs me that he has not infrequently met with six pairs of mammæ in domestic dogs, though the number of teats in most breeds of domestic dogs is *ten*. In some examples,

is rather convex (a trait which often comes out in domestic dogs). The muzzle is shorter than in the wolf, and there is long hair between the pads of the feet. Moreover the general colour of these dogs (except for the winter coat of the Siberian species) almost always tends to bright red-brown, a colour constantly represented in breeds of domestic dog or in the dingo. On the whole, the most dog-like of this Cyonoid group at the present day is the Siberian *Canis alpinus*, and the most aberrant the buansu, or dhōl, of India. The dingo would almost seem to represent a collateral descendant of this group which had retained the third lower molar and had lost the extra pair of teats.[1] Probably the dingo of Australia (to which the semi-domesticated dogs, and even the pariah dogs of India and Western Asia, are nearly allied) represents one of the parent forms of *Canis familiaris*, while the other parent of the domestic dog has been the wolf. The mingling of these two breeds, together, possibly, with a dash of the jackal, has produced all the breeds of domestic dog in existence. Some of these breeds, like the Eskimo dog and the dogs of the Indians in the South-western States of North America, have been derived direct from domesticated wolves, while other breeds of native dogs in Central and South America are akin to jackal-like types of wild dog belonging to the genus *Canis*. I have seen in Achill Island, off the west coast of Ireland, dogs which were simply stunted wolves, exactly resembling the wolf in colour, in brush, in the shape of the ears, and in the arrangement of the masses of hair along the line of the back.

The Cyonoid dogs are, as has been mentioned, somewhat marked off from the Wolf group by their red colour. The male, however, and sometimes the female, generally develops a blackening of the coat over the neck and shoulders and along the back to the tip of the tail. The wolves and jackals are more nearly

chiefly terriers, there are *nine*—four on one side, five on the other. In some fox terriers and (according to the author's investigations) in smaller toy breeds the number is reduced to four pairs.

[1] But it is said that there are sometimes six pairs of teats in the female dingo.

allied to one another in scheme of coloration. They start, so to speak, from a reddish-yellow basis, and as reddish-yellow appears in foxes and in the South American dogs of uncertain alliance, it is probable that it is the original colour of the Dog genus. The black-backed jackal of Africa exhibits the wolf-coloration carried to its most beautiful development of black, silver, and orange. In the European wolf (and no doubt it was the same in the now extinct British form) the limbs are fawn-colour, with a tendency to blackish-brown down the front of the fore paws. The face is umber-brown, with a grizzled forehead, and patches of the same colour on the eyebrows. The back is black, ochre-yellow, and white, owing to the long hairs growing in that region being yellow in their lower portion, white in the middle, and black at the extremity. The edges of the great masses of hair which grow somewhat unevenly along the wolf's back are quite black when seen from the side, but their depths are yellowish-white. There is a good deal of black about the upper surface of the tail. The skull of the wolf scarcely differs from that of the more primitive types of domestic dog, the chief characteristic being a slightly less cranial capacity, and a somewhat longer muzzle. The only real difference would appear to be in the canine teeth, which are proportionately more long and massive than in most known breeds of dogs. The forehead above the orbits is a little narrower and flatter, and the crest of bone along the top of the skull is longer and higher.

The number of mammæ is five pairs, a number characteristic of nearly all breeds of domestic dog.[1] The collar bone is present, but very rudimentary, though usually composed of a longer fragment than in most breeds of domestic dogs. The fore feet are five-toed, but as a rule there are only four toes apparent on the hind feet, though in the bones there are several joints representing the vanishing first toe of the hind foot. Occasionally in the wolf, and much more frequently in the domestic dog, the first toe of the hind foot is represented by what is called the dew claw, situated high up on the inner side of the hind foot.

[1] See note [3] on p. 127.

This is a claw attached to two or three minute phalanges, which are not completely connected with the metatarsal bone of the first toe. On the whole, however, it may be said that wolves and dogs are five-toed on all four feet, and in this respect are more generalised than the South African hunting dog, which has no trace of the first toe on any of the feet. The arrangement of the toes on front and hind limbs in the wolf and in most breeds of domestic dog presents a feature which deserves some attention (inasmuch as painters often misrepresent this): the two middle toes on each foot are pressed closely together, so that their claws are almost touching. The tail is not nearly so long as in the fox, but in most wolves and jackals is bushy. In the Asiatic type of red dog akin to the dingo and perhaps in the Cyonoid group the tail has a tendency to become smooth and short-haired, and this tendency is met with in the development of breeds of domestic dog, a mixture of all the Thooid and some Cyonoid races. The pupil of the eye in the wolf and dog, as already mentioned, contracts to a round point, and not to an elliptical slit.

The present distribution of the various races of true wolf comprises the whole of Asia except Arabia, Ceylon, Burma, Indo-China, and Malaysia, and includes Japan; the whole of Europe except the British Islands and parts of the Continent where it has been recently exterminated by man; North America, from the Arctic Sea to Mexico. No breed of wolf is found in North Africa, Arabia, or Syria, its place being taken by several species of jackal. In South America there are species of dog not far removed from the wolf and the jackal, but offering some affinities to the fox. One of these, *Canis cancrivorus*, possesses the archaic feature of a third molar in the upper jaw.

It is still an open question as to whether the Wolf group originated in Asia or North America. On the whole, it may be decided that Asia was more probably the focus of radiation of the Dog genus—which is, perhaps, the most widely-distributed type of mammal, as it is represented in every quarter and region of the habitable globe, except the isolated continent of Antarctica. The wolf, as a species, dates in European formations from the

end of the Pliocene, and in England from the same period. In the Pleistocene Epoch the wolf spread into Scotland and Ireland, and in Ireland existed in very great numbers—no doubt owing to the fact that it met with no rivalry from hyænas, lions, or other beasts of prey except the bear. In all probability, the wolf of Britain resembled very closely that of modern France and Germany. The fossil bones of British wolves are not in any way to be distinguished from those of existing wolves on the Continent of Europe at the present day.

The Anglo-Saxon monarchs appear to have taken strong measures to reduce the number of wolves in England and in Wales by levying tributes of wolves' heads or skins. But Mr. Harting, in his interesting chapter on the Wolf in *Extinct British Mammals*, brings much evidence to bear to show that, contrary to the accepted opinion of early English historians, wolves were not exterminated in England till the close of the fifteenth century, during the reign of Henry VII. Perhaps the last specimens lingered in Yorkshire, Lancashire, and the forest of Savernake, in Wiltshire. The last wolf was probably killed in Scotland about 1743, and in Ireland (Kerry) perhaps as late as 1766. The predatory nature of this animal probably furnishes a sufficiently conclusive argument against its reintroduction; though, at the same time, it should be pointed out that, whereas the wolf lends a certain picturesqueness to the forests of France and Germany, it seldom interferes with man except during the height of the winter. Its presence in Epping Forest, in the New Forest, and in other great domains increasingly affected by pleasure parties, would greatly add to their romantic interest, and at the same time might wholesomely check the gambols of the beanfeaster and his mate without subjecting them to any worse punishment than a scare.

FAMILY: *URSIDÆ*. THE BEARS

The Bears are more primitive than the dogs, in that they have five completely developed toes on each foot, and are plantigrade; but they have other features which indicate specialisation,

such as the absence of a cæcum, and of an entepicondylar foramen (see p. 149), the presence of a long penial bone, and other peculiarities of the male genital organs, and a rudimentary tail. They possess the same number of teeth as the typical dog (though in one genus there is the occasional loss of one pair of incisor teeth in the upper jaw). Yet there is a tendency in the first two premolars in the upper and lower jaw to disappear. This gives the skull of a bear, therefore, an aspect very different from the skull of a dog, as it induces (when the premolars have dropped out) a large diastema, or toothless space, between the great canines on the one hand and the molars on the other. Nevertheless, in modern bears (as opposed to many extinct genera) all four premolars are represented in both jaws, however rudimentary may be the first three. The fourth, or carnassial, tooth in the upper jaw is proportionately smaller than in the dogs, is blunter, and of little importance as a tearing tooth. This is, no doubt, partly due to degeneration. The molar teeth are large as compared with those of the dog, and have broad, flat, tuberculated crowns. The canine develops into a considerable tusk. The number of teats is usually three pairs, one pair situated on the breast and two pairs along the belly.

The bears, like so many other groups of mammals, seem to have arisen in India, or on the northern limits of that country, where the remains of the first true bear are found in Upper Miocene strata. In Europe they made their appearance in the Upper Pliocene, and the earlier forms of European bear agreed with the brown bear of to-day in possessing four premolars in both upper and lower jaw.

Ursus arctos. The Brown Bear

This species is, in some respects, the least specialised amongst existing bears. Its colour ranges from dark fulvous-brown to silvery-gray. Young bears have white on the throat—a detail of coloration which is seen in other species and genera of bears, and in members of the Weasel group. In Eastern Tibet the brown bear tends towards black in coloration on the upper parts.

The length of a good specimen of European bear may be as much as 8 ft. from the tip of the snout to the root of the tail. The tail in all existing bears is reduced to a mere stump, and is, perhaps, longest in the polar bear. In the brown bear the tail does not exceed 3 in. in length.

The Brown Bear hibernates in the colder districts of Europe and Northern Asia, retiring into some cavern or safe retreat and sleeping until April, in which month the cubs are usually born. These very seldom exceed two in number, and are born blind and naked, being unable to see till about three weeks after birth.

It is a relatively silent animal; snarling, growling, and whining with its companions, but not, as a rule, uttering any cry that can be heard at a distance. When disturbed by man, it gives vent to a loud, gruff bark. The bear can climb trees, and is a good swimmer. Its diet is almost omnivorous.

The present range of the brown bear extends over almost the whole of Europe, except those regions which are thickly inhabited by man, and over all Asia, except such parts as lie within the tropics. In North-east Asia the brown bear almost grades into the great grizzly bear of North America, or the splendid chocolate-coloured Alaska bear. In England the brown bear has existed since the Pleistocene Epoch. Its distribution throughout England, Wales, Scotland, and Ireland seems to have been almost universal. Caledonian bears from Northern Scotland were sent to Rome for the sports of the Circus. The creature appears to have become practically extinct in Scotland[1] (as a wild animal), and equally in Ireland, before the eighth century. In the northern parts of England it may have lingered till about the commencement of the ninth century. Later on it was reintroduced as a tame animal from the Continent, and used in mediæval sports down to a relatively recent period.

It seems to be hardly determined with certainty that the grizzly bear (*Ursus horribilis*) of North America is distinct as a *species* from the brown bear. Extreme forms of both differ

[1] Bell states, in his *British Quadrupeds*, that wild bears may have existed in Scotland as late as the year 1073.

markedly in size, the grizzly bear being in general a much bigger animal than the brown bear. Its coloration also varies considerably, and there are slight differences in the relative size of the tail. Remains of the bear found in Ireland seem to resemble more nearly the grizzly bear of North America than the ordinary brown bear of Europe, and traces of this grizzly bear type are also found in the Pleistocene and recent deposits of England.

Ursus spelæus. The Cave Bear

This creature was in some respects the culmination of the bears, a splendid and awful development of a predatory Carnivore. It was, perhaps, preceded in development by *Ursus priscus*. As a temporary king of destroying animals it probably succeeded the sabre-toothed "tigers," and exceeded the lion in size and strength, besides being more at home in north temperate regions where the lion seldom penetrated. It was nearly twice the size of the brown bear, and exceeded the grizzly bear by about a third. It differs from the other bears in the total loss in the adult animal of all the first three premolar teeth in each jaw, also by the high forehead, the shorter nose, and possibly the higher and more horizontal opening of the nostrils. The upper canines were enormous, but the lower canines not proportionately quite so large as in the brown bear. The under jaw is provided with a strong chin for the attachment of powerful muscles, and is further marked with three deep cavities in the bone on either side. The presence of its remains in absolutely extraordinary quantities in all the caves of England, France, Germany, Belgium, Poland, Italy, Algeria, the Balkan Peninsula, and South Russia would seem to show that this enormous bear used caverns as its home and lair, dragging its prey to be devoured in these retreats, where, its hunger satisfied, it abandoned the remains to spotted hyænas of great size. In England its existence dates from the end of the Pliocene Epoch. It became extremely abundant during the Pleistocene and the Prehistoric age of man. It was certainly contemporaneous with Palæolithic man in these islands, and may even have lingered down to the Neolithic age. So far

Photo by W. P. Dando, F.Z.S.

BRITISH CAVE LION (*Felis leo spelæa*).

Photo by W. P. Dando, F.Z.S.

BRITISH CAVE BEAR (*Ursus spelæus*).

To face p. 134.

as is yet known the range did not extend to Scotland, or further north than Yorkshire. Somewhat doubtful ursine remains in the Shandon Cave in Ireland are attributed to the cave bear, but are more likely of the grizzly bear type.

Family: *PROCYONIDÆ*. THE RACCOONS

This group of small bear-like animals (differing, however, in outward aspect from the bears in that they have tails sometimes of great length) is slightly less specialised than the Bear group in the shape of the molar teeth, but more specialised in that they have lost a molar tooth from the lower jaw, never having more than two pairs in each jaw, as against two pairs above and three below found in all true bears. There is, however, one exception to this in a somewhat transitional animal, the *Æluropus*, or big panda. This creature, an inhabitant of Tibet, is extremely bear-like in appearance, and has a very short, stumpy tail. It was until recently classed with the bears, but it is now put in the family *Procyonidæ*. *Æluropus* has two pairs of molars above and three pairs below. The *Procyonidæ* walk on the soles of their feet (are plantigrade, that is to say). There are other anatomical points in which they are more or less generalised than the bears. They possibly originated from creatures allied to the ancestral bears and dogs in North America or in North-east Asia. They are represented in the British fauna by

Ælurus anglicus. The British Panda

This was an animal quite half again as large as the existing *Ælurus fulgens* of the Himalayas, the only living representative of the genus to-day. The British Panda may have been akin to *Æluropus* now existing in Tibet, which is a very large bear-like panda with a short tail. The remains of the British panda date from the end of the Pliocene period, and were found in the east of England. No doubt the range of this genus and of the allied *Æluropus* stretched once from England to Kamshatka, and thence communicated with the allied forms of *Procyonidæ* in North America.

CHAPTER VII

CARNIVORA (continued). THE WEASEL FAMILY

FAMILY: *MUSTELIDÆ.* THE WEASELS

THIS is a more specialised group of Carnivores than the Bears or the Raccoons. They never have more than one pair of molars in the upper jaw and two in the lower. They preserve, however, one feature in connection with the humerus, or arm bone (the entepicondylar foramen, see p. 149), which makes them a little more generalised than the bears. They branched off, no doubt, from the dog-bear stock not far from the origin of the *Procyonidæ*, and yet also not far from the point of origin of the Civets and the Cats. Perhaps, on the whole, the Weasel group is a family of Carnivores of Old World rather than New World origin, though at the present day they are well represented in both hemispheres. In the most ancient fossil forms there were two molars in the upper jaw. At the present day the *Mustelidæ* are divided into three sub-families—*Lutrinæ*, or Otters; *Melinæ*, the Badgers; and *Mustelinæ*, the Weasels.

The Otters include one genus, *Latax*, the sea otter, which still exists on the Asiatic and American shores of the Pacific Ocean. This animal bears a strange and disappointing resemblance to the seals, and exhibits to us, no doubt with seemingly complete accuracy, the outward appearance of the transitional form which stood between the normal land Carnivore and the thoroughly aquatic seal. But this resemblance is only due to a parallel line of evolution; the otter taking entirely to a marine life has actually got its body and hind limbs shaped to resemble

those of the seals leading a similar existence. The specialised molars and general dentition of *Latax* forbid us to derive either the sea lions or the true seals from the Otter sub-family. The sea otter is a much-specialised member of this sub-family owing to its long, flipper-like hind feet; otherwise in the rest of the otters the feet are short and rounded, and the toes are webbed. The claws when present are curved and blunt. The head is broad and flattened. The kidneys are specialised in structure. In the teeth, however, the otters are a little more generalised than the remaining groups of the Weasel family in that there are four pairs of premolars in the upper jaw. In the lower jaw there are three pairs, and the true molars are two pairs below and one pair above. The single molar in the upper jaw of the otters is excessively large, and the carnassial fourth premolar is also a tooth of considerable size, with a formidable, three-cusped cutting blade. The first premolar is very small, and often absent in adult otters.

Lutra vulgaris. The Common Otter

Besides sharing the general characteristics of the sub-family, the Common Otter may be described as follows:—The full size of the male will measure from the tip of the nose to the root of the tail about 2 ft. 4 in., and the tail would be another 1 ft. 3 in. The body is long and low, the legs are short and powerful. The upper part of the tail is broad, and flattened horizontally. Underneath the tail, as in so many of these carnivorous mammals, there are small glands which secrete a fœtid liquid. The muzzle is very broad, and the upper lip thick and overhanging the lower. The vibrissæ, or "whiskers," are thick, almost quill-like. The small eyes are somewhat prominent on the flat head, and are situated not far behind the nostrils. The ears are short and rounded, and pressed close to the nape of the neck. The lower jaw at its base is broad and bulging. The fur, which is of some value, consists of a very fine and soft under-fur of a pale yellowish-gray colour below and brown at the tips. This is set with longer and coarser hair, which is a shining umber-brown

over all the portion that is visible. The general colour of the upper surface is a bright raw-umber, the chin, throat, belly, and inside of the limbs being grayish-brown or yellowish-gray. Occasionally British otters are spotted with white, especially on the throat and flanks. These white blotches (generally on the borderland between the bright brown hair of the upper parts and the whitish-gray of the belly) commonly occur in Scottish otters. On the other hand, in Ireland there is a tendency towards melanism, some specimens of Irish otters being so dark as to be nearly black above and blackish-brown below.

The number of mammæ in the otter is only one pair. The period of gestation is about nine weeks. They only breed once in the year, and the rutting season is in midwinter.[1] The young are born either in March or April. They are from two to five in number, and are born blind. The nest in which they are born (which, together with the ordinary retreat of the otter, is called its "holt") is generally a large hole in the bank of a river, under the roots of some overhanging tree or a jutting rock.

The cry of the otter is a shrill, whistling noise when contented and at play. They also make a whimpering sound, especially when searching for food on land. If alarmed or excited they utter a shrill bark, varied with a whistling call. They have a keen sense of hearing and of smell, but not a good sense of sight. The long vibrissæ are extremely sensitive, and no doubt the otter is greatly guided by the sensations transmitted through these long feelers to the nerves of the muzzle.

The otter, it is needless to say, swims and dives with great facility, and propels itself with all four limbs, using the tail as a great rudder. It swims in a nearly horizontal position, with the nose just above the surface of the water, unless searching for fish, in which case the otter will swim below the surface, putting up its nose every few minutes to breathe. Although its ordinary habitat in England is large streams or rivers, on the coasts of

[1] It is not certain, however, that breeding may not take place at other seasons of the year, though only one litter of cubs is produced within the twelve months.

Photo by W. P. Dando, F.Z.S.

THE COMMON OTTER.

Photo by C. Reid.

THE COMMON OTTER (*Lutra vulgaris*).

To face p. 138.

Scotland and Ireland the otter takes to the seashore. All round those grand chalk cliffs of Antrim, in North-east Ireland, there are traces of the otter in the hollows in chalk and basalt. It is said to frequent this coast for salmon. It is also found off the coast of Donegal, equally taking to a sea life. The otter is said to kill and spoil more fish than he eats; but fish are so common and otters are so rare that this surely ought not to matter to humanity. When it has brought a fish to shore it generally holds the head between its fore paws, and begins to eat at that end, devouring it downwards till it has reached the fin of the tail, which is discarded.

Otters do not hibernate, and if their streams are frozen over they either migrate to the seashore in search of sea fish, or if that is too far away they turn their attention to land animals. They will eat any bird or small beast they can get hold of, and occasionally attack the poultry and young lambs and pigs of farmsteads. They catch and devour numbers of moorhens, coots, and wild duck. When they are back in the water they not only eat almost every kind of fish, but also frogs, and (on the sea-coast) crabs and shrimps.

Otters are extremely playful creatures, and male, female, and young display much mutual affection. It is an animal which can be readily tamed by man. Bishop Heber, writing in the early part of the nineteenth century, very justly says that the simple Hindu shows a better taste in taming the otter and training it to catch fish for its master than "half the otter-hunting, badger-baiting gentry of England." Professor Bell gives the following directions as to how young otters may be tamed and trained: "They should be procured as young as possible, and they are at first fed with small fish and water. Then bread and milk is to be alternated with the fish, and the proportion of the former gradually increased till they are led to live entirely on bread and milk. They are then taught to fetch and carry, exactly as dogs are trained to do the same trick, and when they are brought to do this with ease and docility a leather fish stuffed with wool is employed for the purpose. They are afterwards exercised with

a dead fish, and chastised when they disobey or attempt to tear it; and finally they are sent into the water after living ones." In this way, although the process is somewhat tedious, it is believed that the otter may be certainly domesticated and rendered subservient to our use.

Whether or not our rustics and gentry have the leisure and patience to train otters to catch salmon and trout, the time has come when active steps should be taken to promote the preservation of the otter, a creature far more beautiful, wonderful, and "obvious" than any fish. If we had ever had a Government that cared for the preservation of beauty in England, the otter would long ago have been placed on the protected list, and would not have been subjected to the undiscriminating attacks of sportsmen referred to by me in the first chapter in this book. It is difficult to conceive an increase in numbers of the otter so gigantic that our fisheries in salt and fresh water could be seriously affected in their abundance. There is always a sort of rude justice, which it is impossible to control and unnecessary to condemn, that keeps the rivalry between man and other mammals in check. If otters became so numerous that they did serious damage to the farmsteads, the otters thus leaving their proper element would very soon get knocked on the head by the indignant owners of poultry, and so kept in proper check, just as in some districts a similar stop is put to the ridiculous increase of foxes beyond bounds that are fair and reasonable.

Otter-hunting generally commences in the late spring, and the dogs used in the sport are the well-known otter hound, a middle-sized, rough-haired hound, probably of Welsh origin, and allied to the harrier. The feet of the otter hound are broad and splay, and the coat is furnished with a thick, woolly under-fur that is very greasy. The ears are long and drooping, and the coat from the nose to the tail is shaggy. The hounds are led to the waterside, where an attempt is made to hit upon the track by which the otter has passed to his retreat in the bank of the stream. On first hearing the hounds, if the otter is at home he dives into the water as soon as they approach. After diving

he remains several minutes under water, and then comes up to breathe. This is called "venting." His course under water is traced by the mud stirred up, or by the air bubbles which rise to the surface from his lungs. As soon as the otter is sighted the hounds are set on him, and pursue him through the stream. Whenever the otter in his course nears the bank, one or other of the sportsmen (all of whom are armed with long spears) makes a dark at the beast with his spear. If he misses, it is considered a rule of the hunt that the owner of the spear should wade into the water to recover his weapon. If the otter is transfixed, however, the owner of the spear goes into the water and raises the otter over his head at the spear's point. As a rule, however, the otter is caught and killed by the hounds. When the otter is first seized by a dog he attempts to dive and remain under water, so that his assailant may drown, not being able to stand immersion so long as the otter himself. The otter administers also fierce bites to his pursuers, occasionally even killing hounds, and by his bravery, pertinacity, cunning, and agility making his insensate slaughter still more regrettable. Yet an otter hunt is a picturesque scene, with the scarlet-coated, white-breeched men armed with spears, the shaggy hounds, and the landscape set with great marsh marigolds; the willows out in fresh leaf; the cascades, the rocks, the stretches of placid water, and the sunshine of May. But when otter-hunting was in full swing many years ago it was not unusual to kill nine otters in a day. If by public opinion or legislation the slaughter of otters could be limited to ten per annum in any one county, it might be possible to keep up a picturesque sport without unduly lessening the number of otters in our rivers.

At the present day the otter is found in the wilder parts of England, in nearly all Scotch rivers, and along the sea-coasts of the north and west of Scotland, and equally widely in Ireland and Wales. In South Wales the otter is quite commonly met with, and the same might have been said about Devonshire until quite recently, where, unhappily, two or more great landowners of that county have made a dead set at

the unfortunate beast because they or their friends have an exaggerated fondness for fly-fishing. The otter has been an inhabitant of Britain since the end of the Pliocene Epoch. It has not yet been obtained in a fossil state from either Scotland or Ireland, and it may, therefore, only have penetrated to those countries since the close of the Glacial age. It could easily have reached Ireland from Scotland by swimming the intervening strait of sea-water. Outside the United Kingdom its range is very considerable. It is found over the greater part of Europe and Asia, even including India and Ceylon. In North America a larger species, nearly allied to it in structure, is also found; while representatives of the genus *Lutra* (some of which, in South America, for example, attain a considerable size) are found all over the terrestrial surface of the globe, excepting the Australasian, Arctic, and Antarctic regions. The otter seemingly evolved from a very generalised type of Mustelid, closely resembling the Civets, and the Otter sub-family can be traced back on the Continent of Europe to the Lower Miocene. It is just possible that the otter originated in Europe, though the group very early attained considerable development in Central and Southern Asia, spreading thence into America.

SUB-FAMILY: *MELINÆ*. THE BADGERS

In this group the fore feet are long, and the creatures are plantigrade in their walk. The toes are straight, and ordinarily the hands are larger than the feet, and are armed with long, slightly curved, blunt claws. The claws of the hind paws are much shorter. They are rather large animals compared with their weasel relations, and their habits are generally terrestrial and burrowing, though several species, like the skunk, may be able to climb trees. All this group (as is the case with so many other Carnivores) possess scent glands round the anus. This feature is developed in the American skunk to a degree met with in no other beast; for the fœtid liquid secreted by this gland is ejected from two conical papillæ, or teats, which can be erected and directed so as to spurt out jets of foul-smelling liquid to a

distance of as much as 12 ft. In the badgers the fœtid slime exuding from these anal glands is rubbed upon vegetation and the soil, and no doubt serves to attract one sex to the other. Occasionally the presence of this foul-smelling exudation lends a fœtor to the badger which has become proverbial.[1] Yet when the creature is kept in captivity it is not particularly odorous, and is said to be cleanly in its habits.

Meles taxus. The Common Badger

The members of the Badger genus (*Meles*) have a dentition which normally includes four pairs of premolars in each jaw, one pair of molars in the upper jaw, and two pairs in the lower jaw. The Badgers, therefore, are more generalised in their dentition than the Skunks (their near allies) or than the Weasels. But they are exhibiting the same tendency to lose the premolar teeth which is so obvious in the Bears, Raccoons, and Weasels. The first pairs of premolars in both jaws are very minute teeth, and often fall out when the animal is adult. Another feature in badger dentition is the large size of the single molar in the upper jaw. This is nearly as broad as long, and almost square in shape, and is much larger than the upper carnassial or fourth premolar. The carnassial in the lower jaw of the badger (which is the first molar) is rather like the first upper molar in appearance, having three low cusps on the outer side and two longitudinal ridges across the upper talon or heel of the tooth.

The body is stout and very broad, and the limbs are short. The length of an average badger from the tip of the snout to the root of the tail is about 2½ ft. The tail, which is very bushy, like a stumpy white brush, is about 7½ in. in length.[2] The badger is quite plantigrade as regards the fore feet, but the hind feet are only semi-plantigrade—that is to say, that it often walks on its toes, and not on the whole length of the

[1] "He stinks like a badger."

[2] A writer in the *Globe* of May 29th, 1903, gives the average weight of Cornish badgers at 30 lb. About the heaviest specimen known is one that weighed 43 lb. (Warwickshire).

foot as far as the heel. The badger only stands about a foot high at the shoulder. The body is much flattened, and the back is very round and broad. Mr. Aubyn Trevor-Battye points out that the badger is able to walk and trot backwards with the greatest ease. It very often moves along with a dancing motion, something like that of its ally, the Indian ratel.

The colour of the badger is whitish-gray on the nose, white on the muzzle and upper lip, lower lip, cheeks, forehead, nape of the neck, middle of the neck, and shoulders ; also the long hairs of the flanks and belly are white. A black mark starts from just behind the muzzle, above the edge of the upper lip, passes across the cheeks and behind the eyes to the base of the ears, and is continued behind the ears on to the shoulder. The rim of the ear (which is broad and rather long) is white, the inside of the ear being blackish. Underneath the chin, on the throat and chest, the colour is black. The lower part of the arms, the fore feet, and the hind feet are also black. The naked nose is a purplish plum-colour. The short, scrubby, bushy tail is white all over the brush, but the hairs round the base of the tail are golden-yellow. The hair on the belly is yellowish-white. A touch of lemon-yellow also marks the white hair ridges on the cheeks. This lemon-yellow is replaced by a reddish tint on the edges of the stiff white hair that marks the sides of the neck. The naked skin of the tips of the fingers and toes is pinkish, and the long claws are pinkish-brown. The whole of the back, from the nape of the neck to the base of the tail, and also the sides, are covered with long coarse hair, which in general is gray, but is a blackish or grayish-brown on the back and pale brown on the sides. The lower ends of these long hairs are often blackish, and when they lie smoothly on the body they seem to mark it with black bands. Old badgers sometimes become quite a light silvery-gray on this part of the body. The claws of the front paws are long and rather horizontal, not much curved. The claws of the smaller hind feet stick out horizontally, and are much worn down.

The skin of the badger is singularly loose for the size of the

Photo by W. P. Dando, F.Z.S.

THE PINE MARTEN (*Mustela martes*).

Photo by W. P. Dando, F.Z.S.

THE BADGER (*Meles taxus*).

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body, so that the creature when seized by any part can turn rapidly and bite. The badger is endowed with astonishing strength of jaw, which it is impossible to dislocate, the lower being articulated with the upper in such a manner that it cannot be detached except by breaking the skull. This strength of jaw, combined with the flattened, ridged molar teeth, enables it, no doubt, to crack up roots, bones, nuts, and other substances. It is almost omnivorous in food, eating nearly every kind of fruit, the eggs of birds, roots, fungi, nuts, honey and the larvæ of wasps and bees, frogs, snails, and insects.

Like most beasts of any considerable size in a wild state, the badger is silent under ordinary circumstances, except during the breeding season, when it grunts and yelps. In captivity, however, when it has ceased to fear making its presence known, it is as noisy as a dog, uttering sharp barks and yelps not unlike those of a puppy.

The sexes do not associate much, except at the breeding season, which appears to take place in October or earlier in the summer-time. The young are born within the deepest recesses of the female's burrow, in a large, snug nest made of dry fern and grass. The young may be born any time between March and June. It would seem as though the normal period of gestation was about six months, but apparently the female badger, like the roe deer, has the power of retarding the development of the fœtus, so that cases are recorded of female badgers having gone with young for more than twelve months.

The young are quite blind when born, and in some cases do not open their eyes till more than a fortnight after birth.

Although each badger dwells alone in its burrow, except, perhaps, during the breeding season, or when the female is rearing her young, they are not wholly solitary, since a number of them seem to make their burrows in close proximity, and frequently a pair or more will go out together to forage for food.

They are nocturnal in habits. Their favourite haunts are the deepest recesses of woods or the copse-clad sides of hills, cliffs, or quarries. At the bottom of some hillside, or possibly under-

neath a bank, or in a disused quarry, it tears out with the long and powerful claws of the front feet (kicking away the earth also with the hind paws) a deep burrow, which at the end probably forks into a couple of holes. The burrow, or at any rate the sleeping chamber, is kept scrupulously clean, and is lined with dried grass and bracken fern or other herbage. Mr. Ellis, who has written much on the habits of the badger, states that in the autumn the old bedding is replaced by fresh, and for this purpose fern and grass are torn up by the badger previously and left to dry in little heaps. In such a retreat as this the badger passes a good deal of the daylight, starting forth at sunset or in the twilight to seek for food. Generally, as the badger leaves the mouth of its burrow it kicks up against it a good deal of loose soil and vegetation to screen the entrance. Badgers hibernate in the British Islands to a certain extent, though not so uninterruptedly as in parts of Northern Europe. Badgers and foxes sometimes dwell together in close proximity and apparently on friendly terms, or at any rate with friendly neutrality. The fox being a lazy animal dislikes the bother of making a burrow for himself, and will sometimes attempt to take possession of one which has been temporarily discarded by a badger. It is said, even, that in one of these burrows with twin nests at the end fox cubs have been brought up on one side and badger cubs on the other.

Badgers readily take to the water, and are good swimmers. Their presence in Ireland, however, is somewhat of a problem, since they would probably not be able to swim across the existing strait between the Mull of Kintyre and the coast of Antrim; yet it is doubtful whether, when the badger entered England from the Continent of Europe by the then existing land bridge, there was still any land connection between Scotland and Ireland. Nevertheless, badgers are found pretty widely all over Ireland, and their fossil remains even have been discovered in caves in the south of Ireland. In England they have existed since the Pleistocene Epoch. At the present day they are found almost throughout England, Wales, Scotland, and Ireland, but not on the large islands off the west coast of Scotland. It is doubtful, also, whether their

range includes the most northern counties of Scotland. Outside the British Islands the range of the common badger extends over the greater part of Europe and Northern Asia. Mr. Lydekker is of opinion that the Badger group originated in Asia, as the remains of the genus *Meles* are found in early Pliocene deposits in Persia, whereas in Europe the animal only dates from the Pleistocene period. In all probability India was also the scene of radiation of this group of the Mustelids, and from India through Central Asia came the ancestors of the American badgers (*Taxidea*) and the skunks. Other allies of the badgers are found in Africa, but the greater number of genera and species of this group inhabit Asia, temperate and tropical, at the present day.

Although the badger must have been well known to all the peoples speaking Aryan languages, it is not often mentioned by Greek or Roman writers, and has a great diversity of names in Aryan tongues. The Latin *meles*, or *melis*, may be connected with the root *mel* = *honey*, and may have been given to it for its love of the honeycomb. Or it may be related to an old Aryan root *mala*, meaning *dirty*. The Greek *taxos* is obviously the same as the German *dachs*. The old English name is *brock*, and the commonness of the badger in earlier times is shown by the frequency with which this word forms surnames of people and names of places (Brockenhurst, Brockley, Brockenden, etc.). Brock, curiously enough, is one of the few words of Celtic origin in English. It is the name of the badger in Irish, Gaelic, and Manx, becoming in Welsh and Cornish *broch*. This word is said to be derived from a Celtic adjective meaning *speckled* or *greyish*. The word "badger" is a puzzle to etymologists. Some think it comes from the word "badge" (derived through Norman-French from Low Latin), and was a nickname implying an animal with a badge or stripe, referring to the black and white coloration of the head. Others would derive it from another Norman-French-Low-Latin word meaning "a stealer of corn," as the badger was supposed to (and quite possibly does) rob the harvest-fields when the corn is quite ripe. "Badger" in Middle English meant a dealer in corn, and was derived through many

corruptions and changes from a Low Latin name (*bladius*) for wheat, which also gave rise to the French *blé*. In France, curiously enough, the badger is called *blaireau*, which might also be connected with wheat in its origin. As, however, it was customary at one period during the badger's persecutions in England to push great sacks up the badger's earth at night-time, when the animal was out foraging, and then catch it when it had bolted into the sack in the early morning, big badgers that were caught may have been called "baggers." In any case, the present name in use arose as a local slang word in Southern England during the fifteenth century, and was sometimes written *bageard*. Getting into the literary dialect of London, it gradually replaced the ancient name of "brock," except in country dialects.

Considering what relatively small harm the badger did to man's possessions, it is curious what a long persecution this interesting animal has suffered, not only in England, the land *par excellence* where man has been cruel to other animals, but also in Germany. Special breeds of dogs (such as the dachshund) were trained for digging out the badger, and in parts of Germany, when the situation of a badger's burrow was located, an instrument like a huge corkscrew was driven down from the soil above till it either transfixed the badger or drove him out of his hole. Badger-baiting in England has given a metaphorical expression to the language. On some properties now badgers are strictly protected, and the protection ought to be made universal in the law of the land, quite as much as in the case of interesting wild birds.[1]

SUB-FAMILY: *MUSTELINÆ*. THE WEASELS

The toes in this group are short, and are united for part of their length by a web of skin. They are armed with short,

[1] An interesting letter on "Badgers," by W. T. Dymond, published in the *Globe* of May 29th, 1903, shows that at one time in Cornwall "ardent all-round sportsmen" thought little of killing "two hundred" badgers in the course of a few years, for no earthly reason but the unreasoning love of destruction which classes us as a race on a level with the worst type of negro.

compressed, and sometimes sharp claws, which in some genera can be partially drawn back, as in the cats. In appearance the molar teeth are very different from the badger's. The fourth premolar is a powerful carnassial, narrow, and with generally two great cusps. The single upper molar is far smaller than in the badger, and is a tooth of no importance, with two tubercles, and is very narrow longitudinally. It is set at right angles to the fourth premolar, and suggests a decided resemblance to the same tooth in the cats.

Gulo luscus. The Glutton

This creature is the largest and stoutest member of the Weasel sub-family, and is almost equal in size to a small bear when full grown. It has a short, bushy tail, and is sub-plantigrade. Its dentition, which is thoroughly musteline, suggests strong superficial resemblances to that of the cats. It has a very large and narrow upper carnassial tooth (fourth premolar), and an equally large lower carnassial (first molar). The outermost incisor tooth, nearest to the canines, is large, and like a second canine in appearance, as is the case in the cats and hyænas. The humerus, or upper arm bone, of the Glutton has what is called an entepicondylar foramen, an archaic feature which has been lost in the existing dogs and in the bears, but has been retained by the cats and the civets (though lost by the hyænas).[1]

The present range of the glutton extends over Norway, Northern Sweden, Northern Russia, Siberia, Alaska, and Canada, and anciently—within the time of man—it inhabited Germany, France, and England. It is first recorded from England at the end of the Pliocene period, and the remains found in English and

[1] This entepicondylar foramen is a curious perforation of the lower end of the humerus, or arm bone, near the condyles, on which move the lower arm bones, radius and ulna. Through this crevice pass nerves and blood vessels. This foramen through the lower end of the humerus is absent in members of the order which includes man (*Primates*). It is also absent in the Rodents and the Ungulates. It is present in Marsupials, Monotremes, and, still more remarkable, the Anomodont reptiles, from which the Mammalia are supposed to be derived. Consequently it is a very primitive mammalian feature.

Welsh caves and relatively superficial deposits show that it lingered on almost to the Prehistoric or Neolithic period.

GENUS: *MUSTELA.* THE MARTENS

The Martens are handsome Mustelids, larger in size than the next genus, which contains the typical Weasels. The body is long, slender, and flexible, though not so disproportionately elongated as in the True Weasels. The head is broad across the forehead, and the muzzle is pointed, the nose being somewhat prolonged beyond the lips. The eyes are large and prominent, and the ears are well developed, broad and rounded at the ends, and heavily furred inside. The paws are somewhat cat-like in shape, and their soles are densely furred between the naked pads. The tail is long and bushy. The under-fur is abundant, soft, and almost woolly, and of a lighter colour than the outer hairs which mark its surface. These are long and silky. The celebrated sable is a marten. Its coat is singularly beautiful, because both the outer hairs and the inner fur are a beautiful reddish-brown.[1] The Martens differ from the Weasels (amongst other points) in possessing four pairs of premolars in each jaw, though the first premolar is small and with only one root. The carnassial teeth are well developed, and possess sharp, bi-lobed blades. In the upper jaw there is only one pair of molars, which are tubercular and very broad transversely, narrow longitudinally, and set nearly at right angles to the fourth premolar. Another feature of the teeth in the Martens is the smallness of the lower incisors and the way in which they crowd together so that they are not placed in an even line. The upper incisors are placed regularly in a straight line at right angles to the length of the jaw. They are long, and rather narrow.

The Martens have not got the unpleasant smell possessed by the True Weasels and derived from the usual anal glands. They are graceful and beautiful creatures, and the beech marten (which is not an inhabitant of the British Islands, as supposed by earlier writers) was domesticated by the Greeks and Romans

[1] "Sable" paint brushes are generally made of squirrels' hair.

apparently before the domestic cat became a common animal, in order to keep their houses clear of rats and mice. In Nipal (to the north of the Indian Peninsula) an allied form is also now domesticated. Seeing how extremely beautiful and much sought after is the pelt of the sable (a Siberian species of marten), it is curious that no attempt hitherto has been made to domesticate this creature and breed it on a large scale for its fur. Instead of doing so the Russian authorities in Siberia are allowing this charming creature to be rapidly exterminated.

Mustela martes. THE PINE MARTEN

This creature is distinguished from its near ally, the beech marten, by the throat and chest being yellow (inclining to white at the side, and orange in the centre) instead of white. The general colour of the upper parts is a chocolate-brown. The ears are edged with white. The under-fur is reddish-gray with a tinge of yellow. But the long hairs of the outer fur are rich glistening sepia or umber. The hair on the paws is blackish.

The length of the Pine Marten is sometimes as much as 20 in. The tail varies in length from 9 in. to 12 in. if it is measured to the end of the long hairs at the tip.

The pine marten probably breeds twice in the year, in February and June. The average number of young in a litter is three, but as many as seven have been reported from Ireland. It generally frequents woods during the breeding season, in order to adapt some bird's nest as a home for its young. In Ireland, however, it often breeds in crevices of the rocks. Although called the pine marten, just as its European congener is called the beech marten, it does not affect the pine in preference to any other tree; but inasmuch as its last resorts in the British Islands are in districts where the Scotch pine is a common tree, and as its habitat on the Continent is Northern rather than Central Europe, it is often found in pine forests. In Ireland, however, it adapts itself very readily to the lichen and moss-covered rocks of the bare mountains. It is generally met with in pairs, there

being more permanent attachment between male and female than is the case with the badger or the fox.

The marten does not hibernate, and appears, like most of the Weasel sub-family, to be more diurnal in its habits than the badgers.

It is a bloodthirsty animal, though not so universally destructive as the stoat. It catches a good many birds in trees, devours young rabbits and hares, rats, mice, pheasants, poultry, and even lambs. In the west of Scotland and on the coasts of Ireland it resorts to the seashore and eats shell-fish. It will also eat ripe rowan berries, blackberries, and other fruit. In captivity it will readily accept a ripe pear or a fig. When surprised in the open by dogs, the pine marten will fight desperately with claws and teeth, and if pursued, bounds over the ground with astonishing leaps of six or seven feet. It makes, of course, for the nearest tree, up the trunk of which it flies with extraordinary speed, its short sharp claws enabling it to obtain a good hold on the bark. In its attacks on birds, and attempts to reach their nests, it is somewhat reckless, and will venture out on to very slender branches, from which it occasionally falls. One specimen seen by the present writer in the south-west of Ireland apparently met its death in this manner by falling from the extremity of a branch, and breaking its back as it struck a strong lower bough in its descent.

The range of the pine marten at the present day (its existence in England and Ireland dates from the Pleistocene Epoch[1]) includes many parts of England (the Midlands, East Anglia, North Devon, Hampshire, North Wales, the Lake District, Northern Yorkshire, and Durham), the Highlands of Scotland, and, until quite recently, the Hebrides (where it became extinct about thirty years ago) ; also the north of Ireland, even to the vicinity of Dublin. The finest specimens of British martens at the present day probably come from the west of Ireland. The author's painting has been done from Irish specimens. The range

[1] Like so many other mammals, the Marten genus seems to have originated in India, its remains in the Siwalik Hills dating back to the Pliocene period.

of the pine marten outside the British Islands includes the whole of Northern Europe and Western Siberia. Its place in Southern Germany, France, and Italy, Eastern Europe, and South-western Asia is taken by the beech marten, which is distinguished by the *white* coloration of the under parts, and by slight differences in the molar teeth. It is melancholy to read in the self-satisfied records of "naturalists," how a fine pine marten was shot quite close to London, in Hertfordshire, not many years ago, and how another was destroyed with equal gusto in some other Home County, and so many more in North Wales. If the persons who shot these martens would only strip off their clothes, let their hair grow, and become wild men of the woods, one would not so much mind their ravages on the British fauna; as it is, they are not nearly so interesting, physically and mentally, as the creatures they destroy, and are generally, in addition, an incongruous blot on the landscape. If martens received a reasonable degree of protection and became more accustomed to man, they would be beautiful objects in the British woods as they scrambled about the branches in pursuit of birds or squirrels; and if other wild birds and beasts not so disastrously harmful as the rat or the sparrow were allowed to co-exist, the marten would have enough to feed on without resorting to occasional ravages on the poultry yard.

GENUS: *PUTORIUS*. THE TRUE WEASELS

The True Weasels (minks, polecats, stoats, and weasels) differ from the martens in having only three pairs of premolar teeth in each jaw. The bodies, also, are proportionately more elongated. The tail is shorter. Members of this genus also differ from the martens in the foul smell of the anal glands, and perhaps, also, in the greater difference in size between the males and the females. It must be admitted that there is much to be said against elevating this generic distinction between the members of the sub-family *Mustelinæ*, especially as many extinct forms of True Weasel possessed four pairs of premolar teeth in one or other or both of the jaws.

Putorius fœtidus. The Common Polecat

The origin of the name of this large weasel is very doubtful. It appears in early English after the Norman Conquest, and it written *polcat*. The second syllable explains itself, but *pole*, or *pol*, is possibly derived from the French *poule*, a hen, because of the fondness this creature shows for attacking domestic poultry; or it may be a variant of the Anglo-Saxon word *ful* (foul). In early English it was also called *foumart*, or "foul marten," from its disgusting smell. In old French this animal was called *fissau* (corrupted in English into *fitchew*, or *fitchet*), and this was derived from an old Low German and Scandinavian verb, *to make a disagreeable smell* (allied to English *fizz* and *fizzle*). Whatever name is given to this creature, whether it be the Latin *Putorius* or the French *Putois*, is connected with the fact of its filthy odour, due to the secretion in the anal glands underneath the base of the tail. The length of a fair-sized male polecat is about 17 in. from the tip of the nose to the base of the tail. The tail, which is short and bushy, is another 6 in. or 7 in. long. The female, on the other hand, may only measure 11 in. to 12 in. along the head and body, with the tail about 5 in. longer. The male polecat in country dialect is usually known as the "hob," a name also given to male stoats and weasels. The first finger or toe on all four feet is very short.

The colour of the polecat is rather handsome. The upper and lower lips are white. The white extends on a little distance over the muzzle, and is succeeded sharply by a blackish-brown, which extends from the under side of the jaws over the eyes and nose. There is a band over the forehead behind the eyes stretching to the extremity of each cheek, which is a dark bluish-gray, with perhaps a tendency in some varieties to become whitish. The blackish-brown colour begins again behind this gray band on the forehead, and includes the ears and neck. The rim of the ear is white. All four legs are black. The greater part of the body has an under-fur, which is dense, soft, and matted, and of a yellowish-brown colour, sometimes quite a pale ochre. This,

From an original drawing by the Author.

THE POLECAT (*Putorius fœtidus*).

To face p. 154.

however, is largely concealed by the long upper hairs, which are glossy black, so that the general aspect of the polecat from the forehead to the tip of the tail is blackish-brown, but this general tone is broken when any raising of the outer hairs reveals the pale yellow of the under-wool. Like the marten and the other weasels, the polecat is a silent animal ; but it can growl fiercely, and when alarmed or in pain it makes a squeaking noise, and will give a low mewing cry to its mate or its offspring.

The female polecat apparently only breeds once a year, in May or the beginning of June, making her nest in a rabbit burrow or in the crevices of rocks, or any other hole or corner more or less concealed by stones or brushwood. The number of young ranges from four to six. They are born blind. There are three pairs of ventral mammæ in the female.[1] The period of gestation is about seven weeks.

The polecat is extremely bloodthirsty, killing much more than it can devour, apparently for the pleasure of killing, or the delight of sucking the hot blood of its victim. It is entirely carnivorous in a wild state, though in captivity it will eat bread and milk. It devours all small mammals, birds, and snakes, lizards, frogs, fish, and eggs. Generally when on the forage it destroys everything within reach, and will then carry away one of its victims to be devoured at leisure. It is more nocturnal in its habits than the marten, but that is rather due to an avoidance of man than to dislike of daylight. It cares little for climbing trees, but will readily take to the water and swim. It does not burrow for itself, but will often take possession of the holes dug by foxes or rabbits. It will often hide in the crevices of rocks and in discarded buildings.

Earlier writers state that the polecat will catch frogs and toads and bite them through the brain in a manner sufficient to paralyse but not to kill them, and that these half-living amphibians are then transferred to its nest, to serve as provender for the young. In one polecat's nest forty frogs and two toads thus dealt with

[1] Sometimes four pairs. In ferrets there are usually four pairs, with occasionally an odd one, making nine in all.

were found close to the five young polecats. As it is also very fond of birds' eggs, it is no doubt a source of justifiable anger on the part of the gamekeeper or farmer. A pair of polecats in a rabbit warren will in time efface the rabbits, while pheasants run a very poor chance of co-existence, since their eggs and young and they themselves are devoured by this rapacious little Carnivore. Nevertheless, it would be a pity if the polecat became wholly extinct, as it is a handsome and interesting creature. Of late years its distribution in England has been considerably reduced, owing to trapping and poisoning. It still lingers in parts of Hampshire, Devonshire, and the Western Midlands, in the Lake District, and in Scotland. Earlier writers include the polecat in the list of Irish Mammals ; but Dr. Scharff informs the author that this is a mistake—that the polecat is absent from Ireland. It does not inhabit the Hebrides or the large islands off the west coast of Scotland. Outside the British Islands its range extends over the greater part of Europe, including the south of Sweden, Russia, and Northern Asia. It is also represented by a closely allied form in North America. At some unknown period it, or an allied species, was domesticated either in North Africa,[1] Spain, or Italy. This domestic type is known to us as the ferret, and is used for rabbit-hunting. For this purpose it was also employed in the Roman world. The Latins called it *Viverra*.[1] From Rome the domestic polecat spread through France to England, where it still shows traces of its Mediterranean origin by its intolerance of cold. The English word "ferret" is probably derived from the French *furet*, which again may have a Celtic origin. It is probably

[1] Roman writers persistently refer to the ferret as having come from North Africa, yet it is curious that up to the present time no species of polecat has been found to exist farther south than Northern Spain and Northern Italy. Further researches may, however, bring to light the existence of this animal in Algeria or Morocco or Southern Spain. If this point, however, must be given up, then it is possible that the polecat may have been domesticated in Northern or Central Spain, and sent thence through the Phœnicians to North Africa in the form of the ferret, on account of the rabbits which existed in Western Mauritania.

[2] A name given by zoologists to the Civet genus.

incorrect to suppose that this name was derived from the Latin *viverra*. The common type of ferret is usually an albino, yellowish-white in colour, with pink eyes ; but not infrequently the ferret reverts to a type of coloration very similar to the polecat, and the two creatures will interbreed.

The polecat is apparently an older species than the weasel or the stoat. It, or a closely allied form, is found in the Pliocene deposits in Central France, and in England its remains are obtained from the uppermost Pliocene deposits of Suffolk. Its remains are also obtained from the Pleistocene deposits of Devonshire and the various British caves. It has apparently not been found fossil in either Scotland or Ireland.

Putorius ermineus. The Stoat or Ermine

The stoat and the weasel differ from the Polecat Mink section of the genus in little more than size and coloration. The blackish-brown of the polecat's body, with its tendency to a black belly, is replaced by the clearly defined reddish-brown upper parts and the almost pure white of the lower portions of the body in stoats and weasels. The last-named Mustelids, also, are markedly smaller in their size. The tail is less bushy, and the feet are so much more covered with hair that the claws are scarcely visible.

The Common Stoat is a handsome little creature, nearly 11 in. long from the tip of the nose to the base of the tail in a full-grown male. The female is a good deal smaller, since she only measures about 9 in. in the length of the head and body. The tail in a male may be about $6\frac{1}{2}$ in. long, as against something under 5 in. in the female. The body has the characteristic weasel proportions of great length compared with the short limbs. It is less plantigrade than the polecat, and runs more on its toes than on the full length of the foot. Its general method of progress is by a series of bounds or a long gallop. Its colour in the summer dress is reddish-brown above and white (sometimes tinted with lemon) below. The edge of the ears, and sometimes the hair along the tips of the toes, is white. The

last third of the tail is black, and these hairs are almost plume-like. The white coloration of the under parts commences with the upper lip, and extends almost to the angle of the ear. It includes the throat, chest, belly, and under side of the limbs. These colours of the summer coat may persist throughout the whole year in stoats found in the south of England, though even in these examples there may be white patches or spots occurring in the winter-time. But in the north of England and Scotland (the true stoat is not found in Ireland), and in the north of Europe, Asia, and America, the stoat assumes that winter coloration which is so familiar to us under the name of ermine fur. The whole of the creature's body is then a pure white, exquisitely tinged perhaps with lemon-yellow, especially near the base of the tail. The terminal third of the tail, however, remains a jet-black colour, and this is made the most of in the preparation of ermine fur, the vivid contrast of the black tail and the white body having very early struck the Teutonic fancy, and thus become associated with royal or noble dress. In the midland counties of England the winter change of the stoat may occasionally be complete, or it may be limited to the spreading of white in irregular blotches over the flanks and limbs, leaving, in some instances, merely a red-brown streak all down the middle of the back.

The eyes are somewhat larger than in the weasel, and the ear conch is perhaps a little more developed. The paws are fringed with such long hair that the pale-coloured claws are scarcely visible, and it is difficult to count the divisions in the toes. The teeth do not differ markedly from those of the polecat in number or in shape. The upper canines are particularly long and sharp.

The stoat breeds about February, and produces young in about April or May. It does not seem to have a second brood within the twelve months. The young, produced in a litter, are not more than five or six in number. The nest is generally made in some hole in a bank, or in the bole of a hollow tree. It is composed of dried leaves and grass, and is warm and dry. When the young are a month old, they may often be seen

From an original drawing by the Author.

THE COMMON STOAT (*Putorius ermineus*): SUMMER COAT.

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frolicking outside the nest, not being particularly timid or alarmed at the presence of man. It is a silent creature ordinarily, but when fiercely protecting its young it utters a chuckling, clucking sound.

The stoat, like the weasel, is famed for its bloodthirsty disposition and unremitting pursuit of its victims. The smaller ones are killed by a bite over the back of the neck; the larger, like hares or rabbits, by the severance of the blood vessels of the throat, on to which the stoat will hang (sucking blood all the time) pertinaciously, so that it will often allow itself, still attached to its victim, to be picked up by a human being. It swims well, and thinks nothing of attacking and killing the water vole. When swimming, the head and upper part of the shoulders are kept well above the surface of the water, the line of the back being just below, and the tip of the tail just showing. It is equally agile in ascending trees and running along the most slender branches. Its disposition is extraordinarily playful. It will sit up on a tripod made by its hind legs and tail and fence at a companion with its fore paws, or leap vertically in the air, performing a summersault, hop or strut on its hind limbs, throw itself over backwards, stopping every now and then in an erect position to utter little pert coughs, as if shocked at the impudence of its companions or of the observer. These extraordinary gambols are said to be part of its system of fascinating its larger and stupider victims like the hare and rabbit. Hares have been observed to gaze with stupid curiosity at this frolicsome creature and its clownish tricks, until at last the stoat in its gambols had approached sufficiently near to dash at the throat of its victim. On the other hand, circumstantial accounts are given of its indulging in these pastimes from a sheer spirit of play, and actually *playing* with the rabbits without winding up the performance with any sinister action. This almost reminds the author of this book of the equally strange proximity, in parts of Eastern and Central Africa, of the lion, leopard, cheetah, jackal, and herds of antelopes and zebras. These beasts of prey may, in those rare districts where Europeans have not made

everything wild and apprehensive, be seen actually strolling round the great herds of browsing beasts without disturbing their equanimity.

The stoat hunts by scent more than by sight, and when in doubt darts backwards and forwards till it is certain that the right track has been hit off, after which it trots along at a rapid pace with its nose to the ground. This creature is almost beneficial to man from the number of voles, mice, and rats which it kills. Young stoats are mainly reared on mice and voles.

The present distribution of the common stoat includes England and Scotland, but not Ireland. It ranges through all Northern Europe, Northern and Temperate Asia down to the Himalayas, and North America almost as far south as the Mexican frontier. In Northern Europe, Siberia, and North America it is known as the ermine when in its beautiful winter dress of lemon-tinted white with a black-tufted tail. The word "ermine" in English is derived through the Norman-French from the Teutonic *harmin* (Anglo-Saxon *hearma*). This again seems to come from a Lithuanian word, *sharmu*. In its summer dress the Anglo-Saxons seem to have often confused the stoat with the weasel. It was called the stoat, or stot, weasel, meaning the bigger, more pushing, energetic of the two beasts. "Stoat" is derived from a Scandinavian and Low German root represented by the Gothic *stautan*, to push. It was a term often applied to male animals in general, and is met with in dialectal English (*stot*) in the sense of a stallion, or a young bullock.

The stoat has seemingly inhabited England since the Pleistocene period.

Putorius hibernicus. The Irish Stoat

This creature is peculiar to Ireland, from which country the common stoat and the weasel are absent. For a long time the Irish Stoat was described as a large weasel, but it would seem to be an independent species, and perhaps a dwarf form of the common stoat. It is a smaller animal than the last named, being barely 9 in. long from the tip of the snout to the base of

the tail in a full-grown male. The female is an inch shorter. The tail is about 4 in. in length, and has a black tip. The coloration is pretty much the same as in the common stoat, but it undergoes no winter change. In all respects as regards habits *Putorius hibernicus* differs very little from *Putorius ermineus.*

Putorius vulgaris. THE WEASEL

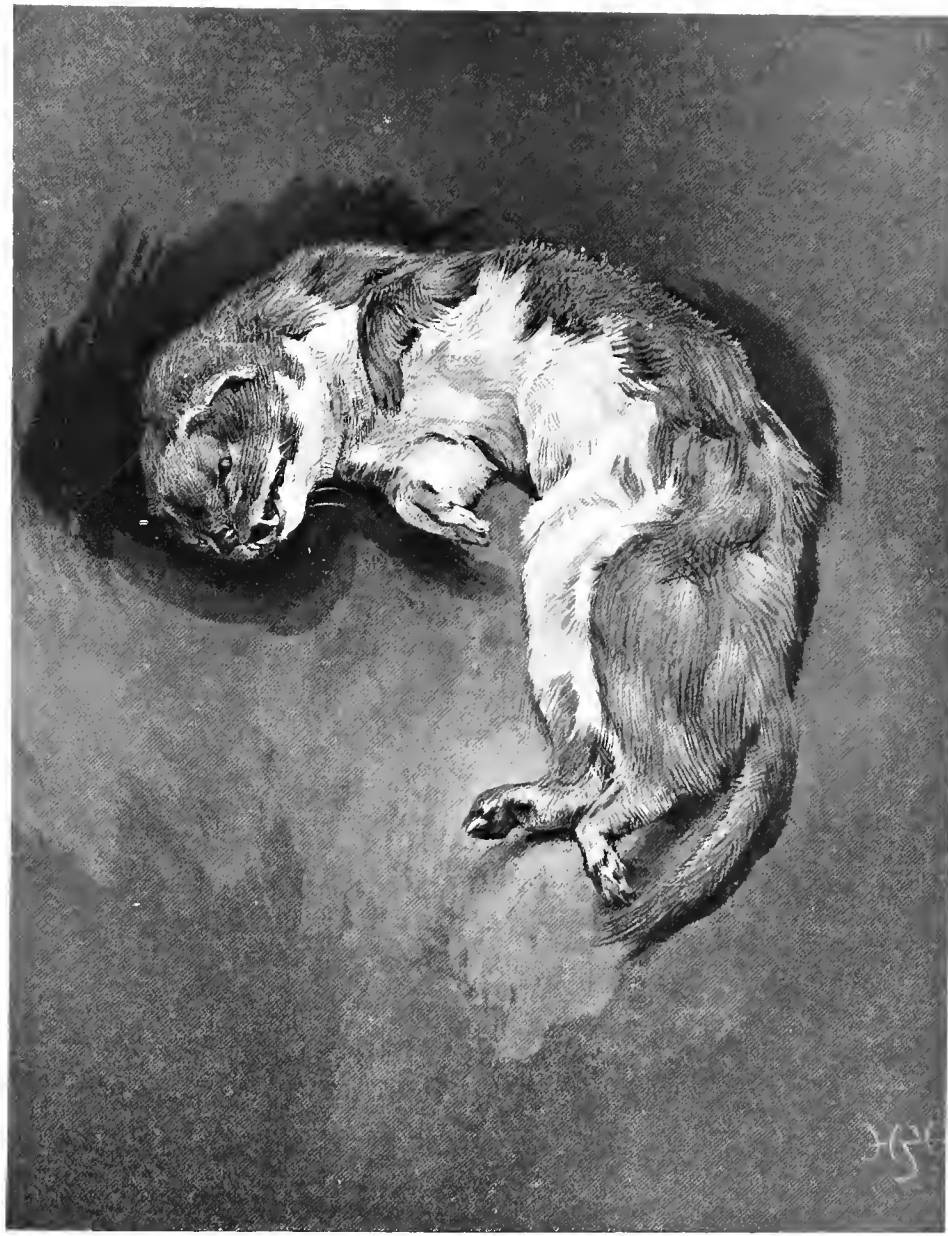
This pretty little beast is the smallest existing Carnivore. The adult female Weasel is only 7 in. in length from the tip of the snout to the base of the tail, and her stumpy little rough-haired tail measures another 2 in. A well-grown male weasel may be slightly over 8 in. in the length of the head and body, and his tail may run to $2\frac{1}{2}$ in. The measurement of the fine specimen from which the author's drawing was made (sent to him from Salsey Forest, Northamptonshire) measured along the head and body nearly $8\frac{1}{4}$ in. The elongated character of the body reaches its most exaggerated development in this little creature, the most snake-like in form of any mammal. The body is not only long and slender, but also arched over the back. The head is small and flattened, the ears very short and rounded. The neck is proportionately longer than in the stoat. The limbs are very short, digitigrade, and the toes are almost concealed by the long, coarse hair which covers the feet. The eyes are small and black. From the muzzle and the brows there are the usual long vibrissæ observable in most of the Carnivores. The colour of the upper part of the head, neck, and body, the tail, the outer surface of the limbs, and the feet is a light reddish-brown, very similar to the colour of the stoat. The short tail is reddish-brown throughout its length, and has no black tuft. From the upper lips and cheeks to the verge of the ear, and all over the under surface of the body and inside of the limbs, the hair is white, generally pure white, sometimes grayish or buff-tinted. The weasel does not usually, like the stoat, turn completely white in the winter in the northern parts of England and Scotland. Occasionally specimens from the Highlands of Scotland have been secured in which nearly the whole of the body was white,

while the tail remained pale reddish-brown; but in Northern Europe, Northern Asia, and Canada the weasel often turns completely white in the winter, a reddish tint remaining in the tail.

The weasel would seem to have two broods in the twelve months. The breeding probably takes place first in January or February, and the young are born, after about six weeks' gestation, in April. Four is the average number of young in a litter; occasionally there are five, or even six. Another brood may make its appearance in July. Cases of three broods in the year are reported. No doubt the number of broods depends greatly on the supply of food, and a vole plague is said to have coincided with great prolificness on the part of weasels. There are three pairs of mammæ. The mother would seem to suckle her young for a month with great assiduity. After this she begins foraging for meat on their account while they remain snug and safe in the nest, outside which they often come to play with one another. When the next brood is near being born the mother turns the first lot of young ones out of the nest, and they probably make a home for themselves close by. Some keepers, however, state that the tiny cubs of the summer brood are born and brought up in the same nest with the spring litter. Young weasels are born blind, but well covered with hair. To form a nest for their reception the female weasel either scrapes out and lines with grass and leaves a former home, or makes a fresh receptacle. She may also establish her nest in a discarded rabbit burrow. As a rule the nests are made in banks, and very often under the overhanging roots of trees. The mother weasel is bold and desperate in the defence of her young, and will fiercely attack dogs who are attempting to tear out the nest.

Weasels, old and young, are sportive, but the young are more playful than kittens, and seem to be full of the joy of living. The same characteristic may be observed in young genets,[1] perhaps the most exquisite little romps that could be found, since they have what the weasel does not possess—beautiful long tails and handsome spots. Nevertheless, the

[1] *Genetta*—allied to Civets.



From an original drawing by the Author.

THE WEASEL (*Putorius nivalis*).

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weasel, for beauty, grace, and interest, can match most other Carnivores, and it argues a great want of geniality on the part of the Northern Aryans that we have not domesticated the weasel, as the Greeks and Romans did the marten and the spotted genet, and as the Egyptians tamed the cat. Perhaps it might be argued that the weasel, being so small and lithe, would have become almost uncontrollable, haunting our houses like the rat, and not confining its destructive powers to rats and mice. But the experiment would be well worth trying.

Except by its short tail, which has no black tuft, and its much smaller size, the weasel differs but little from the stoat, and its habits are remarkably similar. The weasel kills its smaller victims, such as mice, by a single bite on the head which pierces to the brain. In this case, as soon as the animal is dead it generally proceeds to open the skull and devour the brain, which is regarded as a very choice morsel. As regards blood-sucking, it is doubtful whether the weasel or the stoat deliberately apply themselves to this practice with a view to obtaining nourishment; but when attacking all larger mammals or birds whose skulls are not easily attained, or are too hard to be bitten through, it goes for the great blood-vessels under the wing in birds and in the throat of mammals. Having severed these vessels in a rabbit or a hare (for instance), the weasel no doubt greedily sucks at the blood of its victim. The weasel, however, does not as a rule attack prey that is too large to be carried off. Mice or voles are generally carried by the skin of the neck, the head of the weasel being held as erect as possible, so as to keep the hind quarters of its quarry off the ground. Once stowed away in or near the nest, the carcass is eaten at leisure, part of it becoming quite putrid before it is eaten.

The structure of the weasel's body, its long, snake-like neck, short tail, and limbs, enable it to pursue mice, voles, and rats through the tunnels these make in passing to and fro in dense grass, hedgerows, or thickets. Like the stoat, it hunts by scent, and though its sight may often reveal the proximity of a victim, once on the hunt it rarely raises its head above the ground. If

the scent is lost, the weasel retraces its steps, and darts about in every direction till it has picked up the trail. Like the stoats, weasels climb easily and swim well, and will frequently pursue their prey across water. They are sometimes to be met with near corn-ricks ; and the farmer who would slay them then would indeed be a crass fool ; for the weasel will wind its way in and out of the burrows made by mice, and almost, if not entirely, rid the rick of these pests. Weasels are not of quite so much use against rats, because the rat is a strong beast, and has a habit of combining against beasts of prey when attacked in its own quarters. They are more gregarious than stoats and polecats. Parties of four, five, or even eight may often be seen hunting together. Possibly they represent the father and mother weasel and the grown or half-grown young, but apparently they work with the same idea of co-operation as exists in a pack of wild dogs. The distribution of the weasel in the British Islands includes most parts of England and Scotland. It is not found in Ireland, but outside Great Britain it ranges over nearly the whole of Europe, North and Central Asia, and North America. Its fossil remains in Britain do not go back so far as those of the stoat, the marten, or the polecat, and it is probably a creature of later development and greater specialisation. Hitherto the only remains certainly attributable to the weasel have been found in Devonshire and Yorkshire cave deposits. The name "weasel" is of Teutonic origin, and is a diminutive. It is possibly derived from the root *wiz* (compare wizen), to shrink or dry up, on account of the way in which the weasel squeezes through small openings. The female weasel, which is so much smaller than the male, is sometimes taken to be a different beast, and is called *cane*, or *kine*.

CHAPTER VIII

CARNIVORA (continued). CIVETS, MACHAIRODONTS, AND CATS

In order that the reader who is not already a zoologist may apprehend the scheme of the existing Carnivora, an allusion may be made here to the family of the *Viverridæ*, or Civets, although this group has not been represented in England since the Upper Eocene (Oligocene) period, when a species allied to the existing civets of India and Africa inhabited the Isle of Wight, and no doubt other parts of Southern England. If, as supposed, this *Viverra hastingsiæ* is really a member of the genus *Viverra*, it would make it almost the oldest mammalian genus in existence. The Viverrids represent rather a generalised type of Fissipede Carnivore, though a little more specialised in some directions than the Dogs. They are one of those basal groups from which more highly modified types, such as the Hyænas, Cats, and possibly the Machairodonts, sprang.[1] The most frequent dental formula amongst Viverrids is three pairs of incisors in both jaws, one pair of canines, four pairs of premolars, and two pairs of molars. The Civets possess, with few exceptions, the alisphenoid canal and the entepicondylar foramen of the humerus alluded to on pp. 118 and 129.

The Civets are entirely Old World in their range, past and present. The site of their origin may have been Europe or

[1] There is some relationship between the Machairodonts and that aberrant Viverrid of Madagascar, *Cryptoprocta*, which has many cat-like features in its structure and dentition, but differs markedly from the Cats and Civets in the arrangement of the external male genital organs.

Northern Africa. In Europe (including Britain) their remains go back to the Upper Eocene. Down to the present time no remains have been found in Asia of any form of civet anterior to the Upper Miocene. Europe, therefore, may have had the privilege of originating this group, as it may also have given birth to the Dogs, Weasels, Hyænas, Cats, Machairodonts, and even the basal forms of the true Carnivora. With Europe in these developments might have been associated the Continent of Africa, at any rate its northern portion.

FAMILY: *HYÆNIDÆ*. THE HYÆNAS

The Hyænas undoubtedly sprang from the Civets through some such type as the extinct *Ictitherium*. In their divergence from this group they threw off a curious degenerate form, the Aard Wolf (*Proteles*) of Africa. This family has lost the alisphenoid canal in the base of the skull and the entepicondylar foramen of the humerus. The dental formula is reduced in existing forms to three pairs of incisors in both jaws, one pair of canines, four pairs of premolars in the upper jaw and one pair in the lower, and only one pair of molars in both jaws. The teeth, especially the canines and hinder molars, are large and strong. The upper carnassial has a great blade divided into three distinct lobes. The single upper molar tooth is very small, and placed at right angles to the hinder edge of the carnassial premolar. The whole of the hyæna's skull is strengthened with a view to the cracking of bones by the powerful jaw. The limbs are practically four-toed, as the first toes on fore and hind feet are only represented by rudimentary bones. There are anal scent glands under the tail, as in so many of the Carnivora. The genus *Hyæna* at the present day is divided into three species, the first two of which (the striped and the brown hyænas) are closely allied, while the third species, the spotted, is almost generically distinct. The brown hyæna still exists in South and East Africa, and is perhaps the most generalised of the existing forms ; but as no trace of it has ever been found in England it would be out of place to describe it here.

Hyæna striata. The Striped Hyæna

In this and in the brown hyæna the upper molar tooth is more normal in size than in the spotted hyæna, and it has three roots. The lower molar is also proportionately larger, and has a well-developed inner cusp and hind talon. The ears are large and pointed, and there is a mane of long hair on the back from the nape of the neck to the base of the tail. The tail also is very bushy, and the shaggy hair of the body is marked with irregular stripes something like those of the tiger. The present range of the Striped Hyæna is limited to Northern, North-western, and North-eastern Africa (perhaps as far south as Unyamwezi, Kilimanjaro, and Somaliland), Arabia, Syria, parts of Mesopotamia, Persia, Palestine, and India as far south as the Deccan (it does not spread westwards as far as Bengal or southwards as far as Ceylon). Anciently, in Pliocene and Pleistocene times, the striped hyæna inhabited Southern France, and possibly Italy; no doubt also the greater part of Southern and Western Europe. Its range even extended to Eastern England at the end of the Pliocene period.

Hyæna crocuta. The Spotted Hyæna

This is the most specialised of the hyænas. The upper molar is very small, and sometimes has only one root. It often falls out in the adult animal. The carnassial molar in the lower jaw is also reduced in size, and has no inner cusp. The ears are moderate in size and rounded, and the hair along the back forms no mane, and only a very slight one on the neck and throat. The tail is short, and has not nearly so large a brush as in the striped hyæna. Moreover, the markings are spots distributed pretty widely over the body, and not stripes.[1] The female of the Spotted Hyæna shares that peculiarity already described in the female mole, by which the external male genital organs are exactly

[1] In the equatorial regions west of the Victoria Nyanza a local variety of spotted hyæna is found (a skin of which the author brought home and sent to the British Museum) in which the spots are more distinct and black, and are almost prolonged in places into short stripes.

imitated in appearance by the female parts, though the resemblance is only superficial. It thus seems to the casual observer not acquainted with this hyæna's anatomy that every specimen killed is a male.

The present range of the spotted hyæna (which generally attains to a larger size than either the brown or the striped forms) is limited to Africa south of the Sahara Desert. In Eastern and Southern Africa it co-exists respectively with the striped and the brown hyæna. In Somaliland it grows to a great size, and is almost as bold and dangerous as the lion. Its former range in geological history was far more extensive. On the east it reached as far as Southern India, and on the north to Yorkshire. Its remains dating back to the Pleistocene and Pliocene periods have been found in all the countries of Southern, Central, and Western Europe as far north as Saxony, Yorkshire, and Wales. The spotted hyæna first appears in East Anglia at the close of the Pliocene period. In the Pleistocene it swarmed over England and parts of Wales almost down to the arrival of Neolithic man. Many of these hyænas must have dwelt in the caves, in which their remains are found in incredible quantities. They almost seem to have shared these domains on terms of alliance with the cave bear and the great cave lion. At one time this cave-dwelling hyæna was distinguished specifically as *Hyæna spelæa*, just as the cave lion was called *Felis spelæa*; but the cave hyæna was nothing but a very large form of spotted hyæna which inhabited England, France, and other parts of Europe, just as the *Felis spelæa* is nothing more than a very big lion. The range of the spotted hyæna in England (like that of so many animals now of African habitat) does not seem to have extended beyond Yorkshire. No remains of the hyæna have been obtained in Scotland or Ireland.

FAMILY: *MACHAIRODONTIDÆ*. THE SABRE-TOOTHED CATS

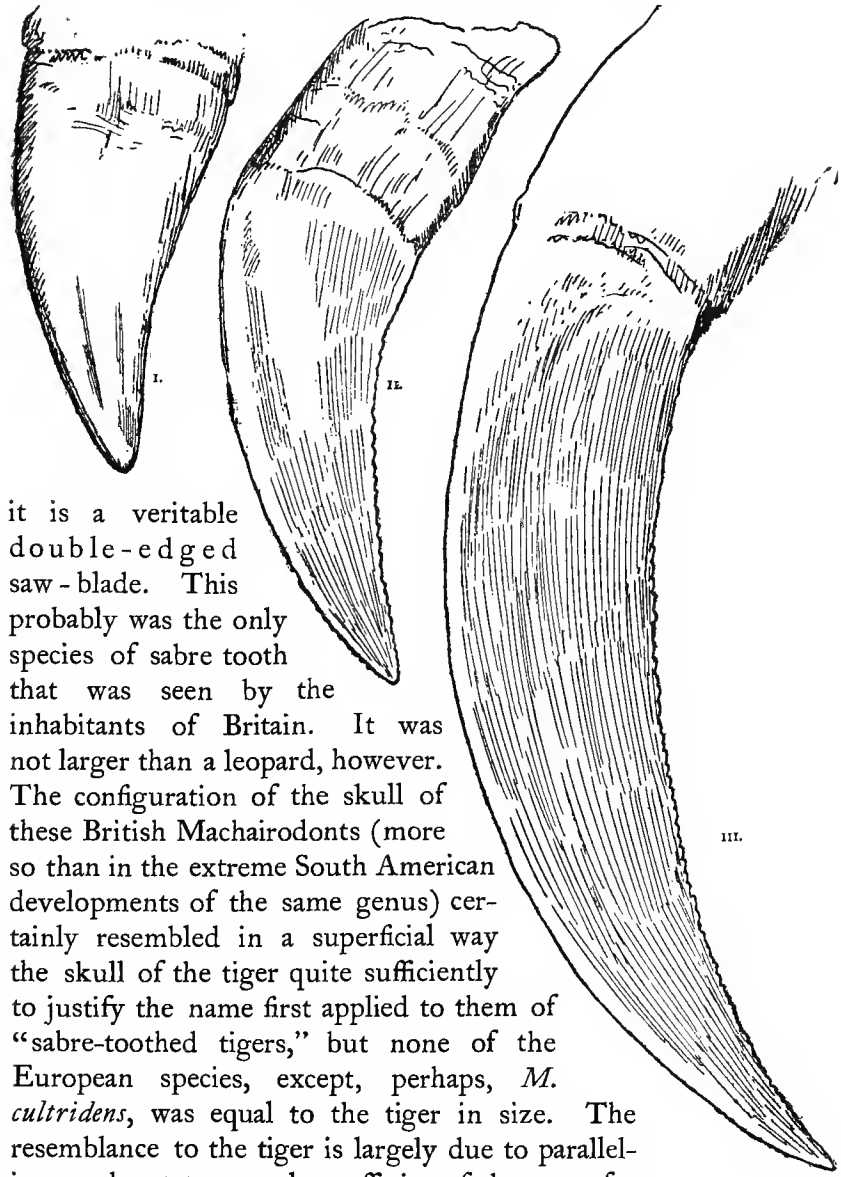
Here we have the destructive carnivorous mammal brought to its most amazing development, a development distancing even that of the lion and tiger, and only exceeded in potency by man

with his weapons and cunning. The Machairodonts are closely related in origin to the True Cats, though, on the one hand, they exhibit more generalised features in their structure, and, therefore, cannot be derived from the existing cats; and, on the other, their dentition shows great specialisation. The general structure of the skeleton is remarkably like that of the Cats, but at the base of the skull there is an alisphenoid canal, together with other features (postglenoid and carotid foramens) of a primitive character lost in the True Cats. The femur, or thigh bone, also retains the third trochanter, a feature which is entirely lost in the True Cats.

In their dentition the Machairodonts begin as very generalised cats with a tooth formula of three pairs of incisors in each jaw, one pair of canines, four pairs of premolars in the upper jaw and three in the lower, and one pair of molars in each jaw. But in the genus *Eusmilus* the teeth were reduced to three pairs of incisors in the upper and only two pairs in the lower, while in the upper jaw there were only two pairs of premolars and a single pair of molars, and in the lower jaw one pair of premolars and one pair of molars. The canine teeth through all this family or sub-family were gradually developed to enormous size and trenchant capabilities, so that in the grandest examples the upper canine may well be compared to a sabre, as it is broad, flattened, thin, and has a finely serrated edge. The great tusks of the sabre-toothed "tigers" differ, indeed, from most developments of tusk-like canines (except in the case of some extinct Ungulates) in their very small diametrical measurement. They are broadened and flattened out like the blade of a scythe. Curiously enough, the most specialised Machairodont (so far as dentition is concerned) appears very early in geological history. This is the genus *Eusmilus*, which makes its appearance in the Upper Eocene. It may even have reached Britain, though no traces of it have yet been discovered. This is admittedly one of the problems of palæontology. It is not until the *Upper Eocene* that any traces whatever of True Carnivores are found. At this stage we find ancestral forms of the Cats, Civets, and Dogs, yet at the same

period here is the most specialised, not only of the Machairodonts, but in some respects of the whole carnivorous group—*Eusmilus*. One would almost hope that the problem might be explained by a mistake having arisen in the attribution of the few known remains of *Eusmilus* to such a remote period as the earliest division of the Tertiary Epoch. The remains of *Eusmilus* would be more in place if they had been found in the Pliocene or Pleistocene.

Machairodus, the sabre-toothed "tiger" *par excellence*, though a little less specialised in teeth, was probably larger in size and more specialised in the structure of its skeleton than *Eusmilus*, and is best regarded as heading up all the family or sub-family of the Machairodonts. This genus seems to have arisen in Europe (France) at the end of the Eocene, but not to have reached its full development till long afterwards, in the middle of the Miocene, when it had already spread out into several other species in France, Germany, Greece, and Persia. In the Pliocene period a form of *Machairodus* had reached England, and its remains are found in Norfolk. During the Pliocene the Machairodonts also spread into India, and possibly farther east. During the Pleistocene the genus produced several species in North America, and the largest and grandest species with the hugest development of sabre tooth (*Machairodus neogæus*) spread through South America to Patagonia. The Pliocene species of Machairodont which inhabited Eastern England was *Machairodus cultridens*, which had a very short muzzle and a tremendous chin spread out below in flanges to act as a protection for the long, broad sabre-tusk when the mouth was closed. In this species the edge of the canine tusk was nearly smooth and almost without serrations. In the Pleistocene period, and co-existent with Palæolithic man in Britain, appeared *Machairodus latidens*, a more specialised form. This is apparently identical with *Machairodus crinatidens*, described also as from the earliest Pleistocene deposits in East Anglia, but chiefly from the Upper Pliocene of Italy and France. *Machairodus latidens* has a shorter, broader, and thinner canine tusk, *both* edges of which are sometimes strongly serrated, so that



it is a veritable double-edged saw-blade. This probably was the only species of sabre tooth that was seen by the inhabitants of Britain. It was not larger than a leopard, however. The configuration of the skull of these British Machairodonts (more so than in the extreme South American developments of the same genus) certainly resembled in a superficial way the skull of the tiger quite sufficiently to justify the name first applied to them of "sabre-toothed tigers," but none of the European species, except, perhaps, *M. cultridens*, was equal to the tiger in size. The resemblance to the tiger is largely due to parallelism, and not to any close affinity of descent; for

EXAMPLES OF UPPER CANINE TOOTH IN LION AND IN TWO MACHAIRODONTS.
Teeth are drawn natural size.

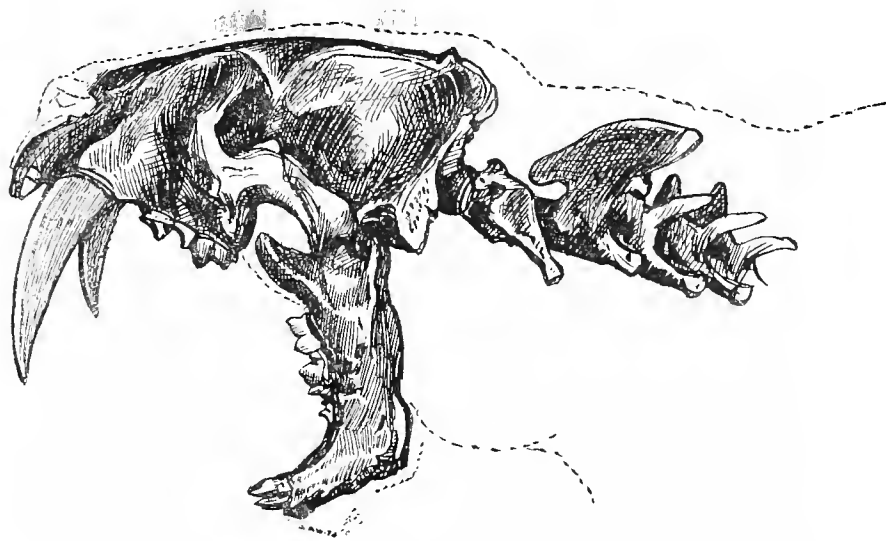
I. Upper canine tooth of Lion (*Felis leo*); II. of *Machairodus latidens*; III. of *Machairodus cultridens*.

to return to the common origin of the tiger and Machairodont one must travel back to the most primitive cats of the Upper or Middle Eocene.

The Machairodonts had retractile claws. The earlier forms were nearly plantigrade, the latter digitigrade, but not quite so markedly as the modern cats. The claws of the largest species must have been even more terrible weapons than those of the lion and tiger, which look feeble in comparison ; and the strength and weight of the tremendous fore limbs are also greater than could be seen at the present day in the biggest lion or tiger. Nothing (I believe) is known as to the tail of the later and bigger Machairodonts. It is possible that this member may have been short or almost absent (as in the bears). In the only complete skeleton yet obtained of *Machairodus neogæus* (from South America), the bones of the tail have either been accidentally lost or the creature was as tailless as a bear. But in *Hoplophoneus*, an early Machairodont, there was a tail of exceptional length and stoutness.

In other respects the Machairodont skeleton is remarkably like that of the cat. As in the cats (and hyænas and bears), the spinous process at the top of the second vertebra of the neck is developed into a huge transverse plate for the attachment and support of the powerful muscles of the head and of the lower jaw. This excessive development of the spinous process of the axis verterbæ shows what tremendous force was given to the bite of the Machairodont. Until recently, however, it was an unsolved problem with biologists how the highly developed Machairodonts got their living (so to speak). The sabre tusks were so long that with the ordinary gape of a feline it was impossible that the creature could have opened the mouth sufficiently to obtain a grip or to take a large bite of any substance into its mouth. It was thought that the Machairodonts might have lived by sucking the blood of their victims ; but the problem was how, unless they struck with the closed mouth—which, again, was obviated by the great development of the flanges of the chin—they would be able to pierce the veins. An American palæonto-

logist, however, in recent researches into the fossil Machairodonts of North America, has offered a solution of the problem which seems sufficient. He points out that the condyles of the lower jaw worked in such a manner on the squamosal groove at the base of the skull that the lower jaw could be pulled back by the muscles attached to the chin and neck until it was drawn right up against the throat. In this manner the Machairodonts obtained an enormous gape, and the powerful lower jaw, with its deep



GAPE OF JAWS IN A BRITISH SABRE-TOOTHED "TIGER" (*Machairodus cultridens*).

flanges, and its short, strong, hook-like canines and incisors, would act as a powerful fulcrum for the vertical sabres implanted in the upper jaw. Armed with such cutting power as this, the sabre-toothed "tigers" probably severed the vertebral column of many a huge Ungulate, and tore off enormous hunks of flesh from the quivering body, which they swallowed with little mastication. They may also, of course, have severed the great blood-vessels and sucked the pumping fountains of venous blood down their gullets.

Possibly, however, over-specialisation told its tale with the

Machairodonts. They could not have died out for lack of provender, or why are they not still subsisting in Africa at the present day?[1] Nor could man have been the immediate cause of their extirpation as early as the Pleistocene. One can only imagine that they became too heavily armed, and that the use of their weapons was too intricate in a life of greater rapidity and fiercer competition; and that, while they starved, the True Cats rose to power through their lither frames and less pretentious teeth.

FAMILY: *FELIDÆ*. THE TRUE CATS

These are, perhaps, the most beautiful and specialised group of the Carnivora. They arose from the basal stock of the True Carnivora, no doubt as a development of the Viverrids, and not far from where the Weasels branched off in the Middle Eocene period. In the Upper Eocene, or earlier, the primitive cats gave off that remarkable branch already described as the Machairodonts. In nearly every respect the True Cats of to-day are more specialised in structure than the Machairodonts, except, perhaps, in the dentition and the shape of the lower jaw. In one respect only are they less specialised than the modern dogs, and that is the retention of the entepicondylar foramen of the humerus, which is entirely absent in every member of the genus *Canis*. On the other hand, they have lost the alisphenoid canal in the base of the skull, and the femur or thigh bone is without the third trochanter which is present in most Machairodonts and early cats. As regards the teeth, there are always three pairs of incisor teeth in both jaws. The canines are long, sharp, and conical or rounded. They are proportionately longest, perhaps, in the species known as the clouded tiger, and the inner edges of these canines, especially in the lion and tiger, are finely serrated. There are three pairs of premolars in the upper jaw, but the first pair is minute, and sometimes missing (as in the lynxes). The tooth answering to the fourth premolar, which is the

[1] It is remarkable that down to the present time no remains whatever of any Machairodont have been obtained from any part of Africa, though they are found in abundance in Europe, Asia, and North and South America.

carnassial in the upper jaw, is three-rooted, as in the dogs, and divided into three lobes in front, with an inner tubercle. The single pair of molars in the upper jaw are minute, functionless teeth on the road to complete disappearance. They are placed at right angles to the long premolar carnassials, are small, and tubercular. In the lower jaw there are only two pairs of premolars, and the first pair is quite unimportant. The single pair of molars in the lower jaw form the carnassial teeth, and are reduced to a large, narrow, bi-lobed blade, perhaps the most powerful cutting tooth in the head. Another point in which the cats are less specialised than the modern dogs is in the presence of fairly well-developed collar bones, though these are not sufficiently prolonged to make the complete shoulder girdle. There are five complete toes on the fore feet, the first, or thumb, being very short and placed rather high up, but provided with as large a claw as the other fingers ; but the hind feet have only four functional toes, the first toe being merely represented by a rudimentary metatarsal bone concealed under the skin. The claws are large in all species, perhaps smallest in the serval. They are strongly curved, compressed, and sharp, and are (except in one genus) completely retractile, though perhaps more markedly so in the fore feet than in the hind limbs. All these conditions of the claws, however, are perhaps exceeded in specialisation by those of the later Machairodonts. In one genus of True Cats, the cheetah (*Cynælurus*), the claws have to a great extent lost their retractility and sharpness, and protrude from the sheaths a little, like those of a dog ; but this is due to degeneration rather than because it is a primitive characteristic, the cheetah having taken to developing great length of limb and swiftness in running. In all cats existing at the present day the ears are of moderate size, the eyes are rather large, and the tongue is thickly covered with sharp-pointed, recurved, horny papillæ, so much so that in the lion and tiger the tongue is a rasp which can remove pieces of flesh from the bone.

The cats for the most part exhibit spots and stripes of dark on light as a marking of their fur, whole-coloured cats, indeed,

being rare as compared to spotted or striped forms. This coloration (often assimilative to surroundings) is, no doubt, a concomitant of their stealthy life, and is more needed by the solitary cats who take their prey by surprise than by bears and dogs who hunt in the open. The spotting and striping is generally lost by such cats, large and small, as have adopted this more open existence. The cat-like markings are possessed by many existing civets and hyænas, and in a less marked degree by the carnivorous Marsupials.

The cats may have been developed from the primitive Carnivores in Europe, in the strata of which continent their remains are found at a more remote period (Upper Eocene) than any yet discovered in Asia[1] or North America. Africa has received a large share of the great and notable cats, but there is nothing in its palæontological history to show that it (Africa) was the original home of their development, all indications pointing either to Europe or Asia. Possibly, as in other cases, Western Asia was the centre of radiation. In Western Asia there seem to have originated the main types of modern cat—the lion, which spread west and north into Europe as far as England, and south-westward into Africa, its eastern range once including the whole of the Indian Peninsula; the tiger, which was evolved in Northern India or Central Asia from a jaguar-like type, and spread north and west perhaps as far as Russia, and north and east till it reached not only the Behring Straits and New Siberia, but possibly also North America[2]; the jaguar, which once inhabited

[1] These continents have not been as well explored for their fossils as Europe. The earliest form of cat found in Asia dates back to the Upper Miocene, and in North America to the Lower Miocene; but it must be remembered that the term "European" as applied to fossils sometimes includes Western Persia.

[2] Remains are found in North America of two great cats about the size of a lion, and very lion-like in skull—*Felis atrox* and *Felis augusta*. These may have been only local variations of the tiger. The tiger is known to have inhabited the Arctic islands of New Siberia, and its range at the present day is not so very far distant from Behring Straits. On the other hand, no trace of the lion has ever been found east of Madras or north of the Punjab.

Eastern Asia[1] and spread thence across Behring Straits into North America, from which it gradually made its way to the southern part of the New World[2]; the leopard, the snow leopard, the clouded tiger, the lynxes, the smaller cats, and the cheetah.

Felis leo. The Lion

Since the disappearance of the Machairodonts and the cave bear this has been admittedly the grandest development of the carnivorous type. It is doubtful even whether for ferocity, for irresistible might, and magnificent dental armature the cave bear should not be counted inferior to the splendid development of lion (known as the cave lion) which inhabited England and France during the Pleistocene period; while as regards the Machairodonts, though in one or two species they attained dimensions exceeding the biggest lion, and their mouths were armed with huge ivory sabres, it must be remembered that these grandest examples of carnivorous development existed in North and above all in South America. The Machairodonts of Europe were certainly armed with big flattened canine tusks, but it is questionable whether they attained the same size of head and body as the big cave lions. Their commonest forms were not much larger than leopards.

The Lion differs from all existing cats, even slightly from the tiger, in the relatively long muzzle into which the face is prolonged, and also in the direction and growth of hair on the

[1] Von Zittel (*Handbuch der Palæontologie—Palaozoologie*, vol. iv.—is my authority for this statement.

[2] A fossil cat, *Felis cristata*, found in the north-west of India, would seem to indicate the existence there of a form intermediate between the jaguar and the tiger. The jaguar (which is, no doubt, only a larger development of the leopard) seems, together with the ocelot, to have once inhabited parts of Eastern Asia, and thence to have reached North America. Its range in North America at the present day is probably confined to Mexico and Texas, but formerly it was met with farther north. It is now most abundant in South America. Consequently its range is a singular parallel to that of the tapir and alligator, both of which are found existing or fossil in Eastern Asia on the one hand and South and Central America on the other.

neck of the male. Even if this hair be not developed into a mane, it stands out somewhat stiffly, and is directed forwards from the shoulder towards the cheeks. This altered direction of the hair of the neck, however, is to some extent met with in leopards and tigers; and in the male tiger there is the beginning of a mane. The lion, tiger, leopard, and jaguar differ from the other cats in the less perfect development of the bones of the hyoid arch (that separate apparatus of bones which supports the tongue and larynx), and in the pupil of the eye, which, when contracted, shrinks to a circular hole, and not a vertical slit.

The lion and the tiger are somewhat divergent forms. The tiger has a more arched and convex profile of the skull. The commencement of the nasal bones also in the tiger takes place much higher up on the forehead than is the case on the lion's skull. There is also a difference in the fourth premolar, or upper carnassial, tooth. It has already been mentioned that in cats, besides the three lobes of the blade of this tooth, there is a tubercle on the inner side. This tubercle is larger and better developed in the upper carnassial of the tiger than it is in the lion. The tiger's skull is also wider and more massive than the lion's, and there are slight differences in the shape of the lower jaw. Perhaps on the whole the lion is slightly more specialised than the tiger, but it is almost certainly a direct development from the Leopard group. So too is the tiger, with perhaps some intervening form like the existing jaguar and the extinct *Felis cristata*. The stripes of the tiger are the large, square rosettes of the jaguar pulled out. In the case of the lion, the markings which may be seen in the fur of young cubs and occasionally of adult females are almost precisely those of a leopard. If we could restore the lion's spots they would be nearly identical in proportionate size and arrangement with the rosettes, single spots, and short stripes of the leopard. There is one particular, however, in which lion cubs differ strangely, both when born in a wild state and in captivity. Sometimes, although the body is spotted like a leopard, the tail is ringed with circular stripes. In

other individuals the tail is marked longitudinally with circular rosettes, exactly like the tail of a leopard.

Gradually, as the lion discarded the forest and took to a life in the open country, the ground colour of the fur, which may have been pale yellowish-gray, deepened into tawny, while the black spots faded into brown, until at last the lion became to all intents and purposes a dun-coloured beast with a black tuft at the end of his tail, black rims and backs to his ears, and a black fringe (more or less) to his ample mane or along the line of the belly. Such spots as remain in the adult lioness on the flanks, belly, and limbs are chestnut-brown, but many of these spots on the lower parts of the body in young cubs are quite black. It might be noted in passing that leopards in the extreme south of Africa (Orange River Colony or Transvaal) have been known occasionally to throw off a curious variety. The size is large, and the build somewhat heavy, like that of a lioness. There are a few black stripes and spots on the head, neck, and limbs, but over the greater part of the body the rosettes have given way to a multitude of tiny black dots, almost merged into the general tawny-gray of the fur. The change of black spots into tawny-brown may also be noticed in the South African variety of the cheetah.

There is absolutely no difference in the structure, size, colour, mane, or any other particular between the existing lions of Asia and of Africa, but it is possible that the huge lion which once inhabited Western Europe during the Pleistocene period may still have retained the distinct black spots of the original leopard markings, which have only faded in the more desert-loving type that has since populated Western Asia and the whole of Africa.

The range of the lion at the present day is limited to a small district of Kathiawar, in Western India ; to a strip of Southern Persia, the valley of the Tigris and Lower Euphrates ; to a small portion of Southern, South-eastern, and South-western Algeria (and perhaps the adjoining territory of Morocco south of the Atlas) ; and to those regions of Africa south of the Sahara Desert from Senegal on the west across Nigeria to the Egyptian Sudan,

Abyssinia, and Somaliland. South of this line the lion is still found all over Southern Africa except the dense forests of the West Coast and of the Congo Basin, and all the settled regions of British South Africa. But within the Historic period the lion was found throughout North Africa from Morocco to Egypt, in parts of Arabia, Southern Persia, Palestine, and the whole of Western, Southern, and South-eastern India, in Asia Minor, the Balkan Peninsula, Greece, and Rumania. In Prehistoric times the lion inhabited much of Austria, Southern Germany (it attained a very large size in Bavaria), and Eastern France; while doing the Palæolithic age the lion extended its range over France, Spain, and Britain. In our own country the lion seems to have swarmed during the Pleistocene period, even contemporaneously with the Ice age. Its remains have been obtained from nearly every English county as far north as Yorkshire and the north of Wales. It does not seem to have reached Scotland, and no trace of its remains are found in Ireland. Its range, in fact, in Britain was coincident with that of so many other mammals now characteristic of Asia and Africa which entered Britain from the south-east during the Pleistocene period, and are found in greatest abundance in the eastern counties. The lion was certainly contemporaneous with Palæolithic man, and may have lingered on down to the coming of the superior Neolithic races.

Felis pardus. The Leopard

The Leopard, whose present range includes nearly all Tropical and Sub-tropical Asia, and the whole of Africa (except the Sahara Desert and Egypt), inhabited Asia Minor and possibly the Balkan Peninsula during the Historic period. Further back than that it was a native of Italy, Spain, France, and Southern England. In our own land it was far scarcer (judging by the paucity of its remains) than the lion, but undoubted bones and teeth of leopards have been found in the caves of Dorsetshire, Somerset, and Devon.

Felis lynx. The European or Northern Lynx

The lynxes are fairly large, long-limbed cats, with tufts of hair at the points of their ears, and in most species with a mane growing from the cheeks. They are further characterised by their short tails (sometimes reduced to a mere stump), and by a tendency to lose the minute anterior pair of premolars in the upper jaw. On the other hand, there is a rudimentary talon to the carnassial molar in the lower jaw, which is a more archaic feature than is possessed by other existing cats. Their coats, when marked at all, are variegated with small spots and short stripes formed by a union of spots, but never by rosettes. One member of this group—the common lynx, now found in Northern Europe and Temperate Asia—inhabited England during the Pleistocene period. Its remains have been found in Durham, Yorkshire, and Derbyshire. It may have lingered here much later than the lion, almost down to the Historic period, for it was only extirpated in France during the nineteenth century, and still exists in Germany.

Felis brevirostris. The Short-faced Lynx

This was a large cat, now extinct, the size of a lynx, with a short face, which has left traces (dating back possibly to the commencement of the Pliocene) in Derbyshire as well as in France and Italy.

Felis caffra.[1] The Egyptian Cat

This is a small and common wild cat of Africa, being found (with some gaps in its distribution) from Algeria and Egypt to the Cape of Good Hope, and from Senegal to Syria and Arabia. Anciently it was found in Southern Europe, and its range seems even to have extended to England (Somersetshire) within the Pleistocene period. It is a slimmer animal than the European

[1] Local varieties of this cat in Egypt, Syria, and Arabia are somewhat unnecessarily elevated into separate species, *F. maniculata* and *F. caligata.* These names are practically only synonyms of *F. caffra.*

wild cat, and has a thinner, longer tail. Though its markings vary considerably, it seems to be without the true tabby striping on the sides of the body. It breeds readily with the domestic cat, of which many consider it to be the main progenitor.

Felis catus. The Wild Cat

This animal, it must be confessed by all honest observers, nearly resembles in appearance that type of the domestic cat which is familiar in Northern Europe and Temperate Asia. The head is strikingly similar in appearance and shape, but is proportionately larger. The tail is shorter and thicker, ending in something like a large brush, which is very boldly striped with black rings. *Felis catus* is larger than the ordinary breeds of domestic cat, the average length of males being 1 ft. 10 in. from the tip of the nose to the base of the tail, which measures another 11 in. or 12 in. Bell, in his *British Quadrupeds*, mentions that a large specimen was killed near Cawdor Castle (in Scotland) which measured 3 ft. 9 in. from the tip of the nose to the end of the tail. The vibrissæ, or "whiskers," are white, and are more numerous and a little thicker than in the domestic cat. The eyes are large, and of a yellowish-gray. The general effect of colour is lighter and yellower than that of the tabby domestic cat, though the markings are similar. The ground colour of the thick fur is yellowish-gray, and the markings consist of short, irregular stripes, which are vertical, and not horizontal, on the upper part of the body, but tend to become horizontal on the limbs. The markings on the forehead and cheeks are exactly like those of a tabby cat. There is a large black tip to the bushy tail. The chin and the throat, the edge of the upper arm, and the fur of the under parts are often white, as are sometimes the extremities of the toes. The fur on the soles of the feet is black in the males. The claws are gray. In fact, this is a noteworthy point in the whole of the Cat family, that the claws always range in colour between yellowish-white and pale gray, and are never black, as in some dogs, bears, weasels, and civets. The female cat is smaller than the male, and is palish in coloration, the

Photo by the Scholastic Photo Company.

THE FERRET, DOMESTICATED FORM OF POLECAT (*Putorius fœtidus*).

Photo by P. L. Pemberton, Esq.

THE WILD CAT (*Felis catus*).

To face p. 182.

stripes being more broken up and fused into the grayish-yellow colour of the fur.

The wild cat probably breeds twice in the twelve months. There are from four to five kittens in a litter. The first litter is born in the early spring and the second in the autumn.

This creature is, of course, purely carnivorous in the choice of its food, and will attack and kill prey as large as a roebuck fawn. It also kills and eats lambs, and, of course, large quantities of rabbits, hares, grouse, pheasants, wood-pigeons, and other birds, besides fish which may be stranded on the banks of a river or a lake. It is an exceedingly fierce animal, and practically untamable in captivity. It is a more forest-haunting creature than the allied forms that prefer the open steppe and desert; in fact, the wild cat is probably found nowhere far from trees, and it not only pursues a good deal of its prey (squirrels and birds) up and down the branches, but generally makes its breeding nest in some hollow or fork of the trunk, or even in the large nest of woven sticks made by a hawk, a crow, or a heron.

The wild cat of Britain and Central Europe belongs to the Catine group of the genus *Felis*, the members of which are all relatively small, with rounded heads, short muzzles, and a tendency towards a tabby or dull coloration occasioned by the relatively long fur, and characterised by the absence of bright red or yellow tints and definite jet-black markings. Although the tail in the African form (*Felis caffra*) is fairly long and slender, the general tendency in this group is towards the development of a short and very bushy tail. This group includes (amongst others) the aforementioned *Felis caffra*, the Wild Cat, Pallas's Cat (*Felis manul*), the Indian and Central Asian Desert Waved Cats (*Felis ornata*, *F. shawiana*, and *F. torquata*), and probably the Colocollo and Pampas Cats of South America; possibly also the Leopard Cat and Rusty Spotted Cat of India.

The author has inflicted on his readers this somewhat tedious enumeration of the allies of the wild cat in order that he may focus their interest on the origin of the domestic cat. Like the

domestic dog and ox (possibly also the sheep and the pig), the origin of the domestic cat has, no doubt, been a multiple one. Those who would deny all participation of the wild cat in the creation of this domestic species are simply unobservant persons. There is no doubt that the average tabby found in France, Britain, Germany, and the colder regions of Asia is more nearly allied to the wild cat than to *Felis caffra*, which is unquestionably the principal ancestor of the domestic cats of Egypt and the countries bordering the Mediterranean. On the other hand, all the Asiatic species above enumerated as allies of the wild cat seem to have had their share in the ancestry of the domesticated cats of India, Asia Minor, Persia, Tibet, China, and Siam. A cat was probably first domesticated in India and in Egypt, especially in the last-named country. The cat which the Egyptians domesticated was the *Felis caffra*, the common wild cat[1] of all Africa, Syria, and Arabia. The domesticated *Felis caffra* was sufficiently near in origin and size to the other European and Asiatic members of the Catine group to interbreed with them. Consequently, when the domestic cat of India and Egypt grew into favour owing to its capacity for destroying rats and mice which had begun to infest human habitations, it spread from Africa and Syria into Mediterranean Europe, where it displaced the tamed martens which had previously been domesticated for the same purpose. As this domesticated Eastern cat spread into Asia Minor, the Balkan Peninsula, Central and South-western Europe, it interbred freely with the wild cats of those regions. The same thing occurred when the domesticated cat spread eastwards and northwards from India. In this way were produced the many different breeds of domestic cat existing at the present day. It would probably have been impossible to domesticate the wild cat of Europe unmingled with any other type ; but when tame female cats of

[1] *Felis caffra* (as already stated) is by some authorities divided into two species, *F. caligata* and *F. maniculata* ; but there seem to be no valid grounds for these divisions of a species which, like most cats, shows considerable local variations.

the Eastern kind wandered out into the forest, as is still their wont, and entered into intimate relations with the male wild cats of the district, their progeny, though perhaps at first a little less docile, preferred the comfortable home of the mother to the precarious existence of the father. Yet the female half-breeds again and again strayed into the woods, became impregnated by the wild cats, and returned to domesticity. Thus at the present day the ordinary type of domestic cat in the British Islands, and in all the British possessions or daughter nations abroad, the domestic cat of Northern France, Germany, Central and Northern Europe, has more of the blood of *Felis catus* in its veins than of *Felis caffra*. On the other hand, the author has noticed that domestic cats imported into Eastern Africa (for example) constantly strayed into the woods in the breeding season and interbred with *Felis caffra*.

The wild cat has existed in Britain since the Pleistocene Epoch. As a species, in fact, it was co-existent in England with the mammoth, the lion, the hyæna, the reindeer, and the hippopotamus. I am not aware that its *fossil* remains have ever been found in Scotland. It has never been an inhabitant of Ireland at any time, and the reports of wild cats in that country simply refer to the domesticated cat which has returned to a feral condition, and which by its descent (already described) from the wild cat of England and Scotland resembles the wild species so closely, except in the length and shape of the tail, that confusion on the subject was excusable. It is possible that the wild cat is a relatively recent immigrant into Scotland, having gone up north together with the big cattle, the red deer, the roe deer, and the wolf, owing to the gradual withdrawal of the ice, and the attacks on wild beasts made by the more numerous human inhabitants of South Britain. Its fossil remains dating back to the Pleistocene are abundant in English and Welsh formations. It remained an inhabitant of most parts of forested England down to a relatively recent period—say four centuries ago. Owing to its ravages on flocks and poultry it was detested by the country folk, and as soon as firearms came into general

use the wild cat's days were numbered. It lingered on in the wilder parts of Northern England, such as the Lake District, down to about the middle of the nineteenth century. It is not quite certain yet whether it is absolutely extinct in North Wales. It is safest to assume, however, that it is, and that there are no specimens of *Felis catus* now existing in a really wild condition out of Scotland, and here they are extinct everywhere south and east of a line which, commencing at Oban on the western coast, would pass through Perthshire to the vicinity of Aberdeen. It is certain that they still exist in the Reay Forest in Caithness and in Assynt Forest in Sutherland. They have always been unknown in the Hebrides, and on any of the large islands off the west coast of Scotland, except, perhaps, the island of Mull. Outside Great Britain the range of the wild cat extends at the present day through Northern Spain, the wilder parts of France, Germany, Switzerland, Hungary, Poland, South Russia, parts of the Balkan Peninsula, Asia Minor, and Northern Persia. In Siberia its place seems to be taken by Pallas's Cat (*Felis manul*).

CHAPTER IX

CARNIVORA (continued)

SUB-ORDER: *PINNIPEDIA.* THE MARINE CARNIVORA

THIS sub-order includes the Sea Lions, Walruses, and Seals, three very distinct families of carnivorous animals addicted entirely to existence in the water, and almost wholly marine in their habitat, only entering fresh water when it is directly connected with the sea. They are not modified for life in the water to such an amazing extent as the whales; they are, in fact, amphibious, and always resort to land during the breeding season, if not oftener, for repose. The descent and relationships of the Fin-footed Carnivores is still a matter of perplexity to zoologists. They differ from the Fissipede, or Separate-toed Carnivores, in the structure and arrangement of their molar teeth. These in the seals, sea lions, etc., are placed in a perfectly straight row, and offer no resemblance either to the tuberculated molars of the True Carnivores or to the exaggerated development of their lobed carnassial teeth. They also never possess in the adult the complete three pairs of incisors in both jaws, and the incisors are most reduced in numbers in the lower jaw. In the least specialised forms the formula is three pairs of incisors in the upper jaw and two pairs in the lower. But if it be the case that the milk dentition in the walrus shows three pairs of incisors in *both* jaws, it would seem that too much stress need not be placed on this diminution of the incisors as a point of difference between the Pinnipede and the Fissipede Carnivora; the more so as this reduction in the lower incisors occurs in one genus of Otters and

in one genus of Machairodonts, while a tendency towards loss of the lower incisors is beginning in the weasels.

The true molar teeth in the seals are tending towards disappearance. They are paltry in size and development, and often reduced to mere rounded stumps. They are never more in number than two pairs in the upper jaw and one pair in the lower. The premolars are larger in size than the molars (usually), and, like the last-named, are simple, narrow, three-cusped teeth (where they are not reduced to rounded stumps or mere cones). It would seem to be impossible, having regard to the structure of the teeth, to derive the seals from the bears or the otters, or from any other form of existing land Carnivore. On the other hand, the teeth do offer some slight resemblance to those of the Creodont Carnivores, such as, for instance, those of the family *Palæonictidæ*. This family contains one genus (*Patriofelis*) which presents a similarity to the seals in the construction of its feet, though it is more differentiated in its reduced premolar teeth. In the vertebræ the seals are more related to the Creodonts. The alisphenoid canal is present in several examples of the Pinnipede, and is also present in most of the Creodonts. It is absent from the otters, though it is present in the bears, the dogs, and some other Fissipedes. A remarkable resemblance to the Creodonts exists in the formation of the astragalus (one of the ankle bones). The special resemblances which the seals offer to the bears and to the otters consists in the lobulated kidneys, and in that portion of the brain called the "ursine lozenge," which rises in the middle of each hemisphere. But another point in which the seals differ markedly from the whole group of bears, weasels, otters, etc., is that in the latter there is no cæcum, or blind gut appendage, to the alimentary canal, whereas a cæcum exists (even though it be very short) in all the seals. All seals are described by biologists as having an extremely short tail. It would be more correct to say that the external tail is reduced to a stumpy lump or tuft; but there are a fair number of caudal vertebræ remaining, so that the seal is really a creature with a moderately short tail, the bony part of

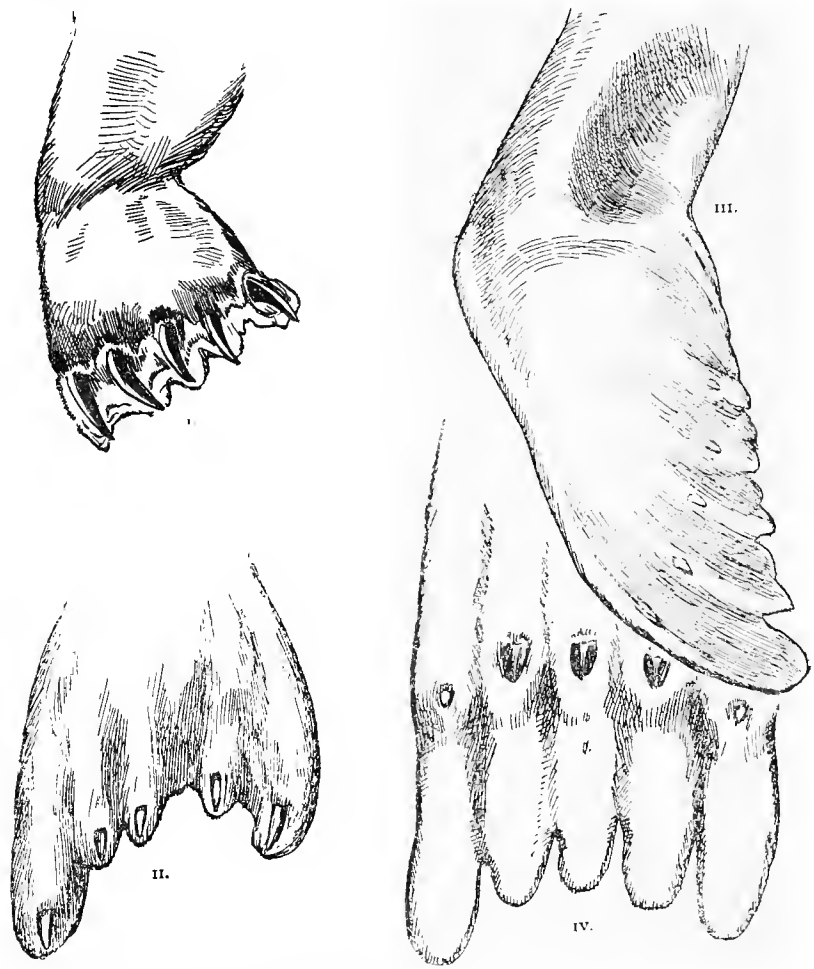
which is but little protruded from the surface of the body, and the reason for this is that the bones of the hind limbs are directed backwards on a line with the tail and are bound up with it, so to speak. Another peculiarity of the seals, in which they differ from all the Fissipede Carnivora, is in the arrangement of the toes of the hind feet. In most Mammalia the middle toes (third and fourth) are longest and the first and fifth are shortest.[1] But in all the seals the first and the fifth toes have become strong and long, whilst the intermediate toes are shortened and are provided with much thinner bones. Undoubtedly the sea otter (*Latax*) and the rest of the Lutrine group suggest obvious resemblances to the seals in the shape and conformation of the head, body, and limbs; but these resemblances are only due to the similarity in the mode of life, and do not require to be explained by the descent of the seals from an otter-like form. Moreover, the seals date back in geological time as far as or further than the otters or bears.

Consequently we must regard this interesting group of aquatic Carnivora as being, in all probability, direct descendants from the Creodonts, that early group of Carnivores, who died out on land because they could not sufficiently quickly develop large brains to compete with the more highly organised True Carnivora. In the water—in the sea particularly—the aquatic Creodonts met with a less vigorous competition, and had time to turn their attention to enlarging their cranial capacity, with the results that their descendants, the seals, have become large-brained creatures who are (were) able to hold their own on the sea-coasts and the ice-floes until man—Caucasian man especially—decreed their destruction for the sake of their skins, their oils, or their tusks, or merely because they made excellent pot-shots for yachtsmen.

It would seem from such evidence as we have that the seals as a group originated in North America, and thence spread down the Atlantic and Pacific coasts of the New World to Antarctica, where at the present day they are the only land mammals. From

[1] In man the first toe has become the longest.

Antarctica they reached the Indian and the South Pacific Oceans, while from the Atlantic coasts they became circumpolar, and also spread to the Mediterranean.



FORE PAW AND HIND PAW OF COMMON SEAL COMPARED WITH FORE PAW AND HIND PAW OF SEA LION.

I. and II. Fore paw and hind paw of Common Seal (*Phoca*).
III. and IV. Fore paw and hind paw of Sea Lion (*Otaria*).

The sub-order Pinnipedia is divided again at the present day into three families : (1) *Otariidæ*, or Eared Seals (Sea Lions,

etc.); (2) the *Trichechidæ*, or Walruses; and (3) the *Phocidæ*, or True Seals. The first-named family (which is not represented by any British species) still possesses small ear conches or outer ears. It has an alisphenoid canal for the passage of the carotid artery at the base of the skull. Its members are able to use their hind limbs in a normal mammalian fashion, and, in fact, to walk with them. The muzzle is rather bear-like, and the nostrils are situated in the normal position at the end of the muzzle. The testes, instead of being entirely retained within the body, as in the Walruses and True Seals, descend into a scrotum. The Otariids also have a postorbital process rising out of the zygomatic arch, or cheek bone, and assisting to define the orbit of the eye. This is less observable in the True Seals, but is present in the Walrus.

On the other hand, the molar teeth of the Otariids are even more degenerate and simplified than in the True Seals, and although they are able to turn their hind limbs forward for walking, the structure and appearance of the feet are more specialised than in the True Seals, because beyond the bony ends of the toes and their nails the webbed skin is prolonged considerably into a deeply lobed margin. The fore paw, or flipper, is also highly modified, having no outwardly separable fingers, while the terminal phalanges are only armed with small, useless nails.[1] In the conformation of the fore limb the Otariids are much more specialised than the True Seals.

FAMILY: *TRICHECHIDÆ*. THE WALRUSES

Odobænus rosmarus. THE WALRUS

It is doubtful whether there are two species of Walrus, or whether the differences between North Pacific, Arctic, and Atlantic forms are any more than a marked variation of sub-specific character. The characteristics of the Walrus family can be best illustrated in describing the only known genus and species of this remarkable Pinnipede.

The walruses anatomically are more nearly related to the eared

[1] In the hind feet the three middle toes of the Otariids retain longer and stronger claws.

seals or sea lions than to the True Seals (*Phocidæ*). The walrus is able to turn the hind feet forwards, as in normal mammals, for purposes of locomotion. It also agrees with the Otariids in having the skin of the feet prolonged into lobes beyond the termination of the toes, and also in the very feeble nails on the fingers of the fore paws. The claws on the hind feet are proportionately longer than in the Otariids. In the base of the skull there is an alisphenoid canal as in the sea lions, and there is a small postorbital process. The testes, however, do not descend into a scrotum. The nostrils are dorsal in position, and more like those of the True Seals. From both sea lions and True Seals the walruses differ markedly in their dentition. In the first place, in the very young animal there are three pairs of minute incisors in both jaws, an archaic feature lost apparently even in the milk dentition of the Otariids and the Phocids. But in other respects the teeth of the walrus show an extraordinary specialisation. In the adult animal the grinding teeth are practically reduced to three pairs of premolars in each jaw, and these are simple, rounded teeth without any distinct cusps. The incisors are reduced to a single functional pair in the upper jaw, and disappear altogether in the lower jaw, while the lower canine is a small, round, blunt tooth like the premolars. Sometimes a fourth premolar tooth of extremely minute size persists in the lower jaw, and an equally minute fourth premolar and first molar in the upper jaw. But the upper canine teeth are developed into a pair of enormous tusks, longer by far even than the huge canine tusks of the sabre-toothed Machairodonts. Just as the elephant is the mammal which has developed incisor teeth most extravagantly, so the walrus is the mammal which has carried furthest the development of the canine teeth. The longest tusks as yet obtained from this animal measure 31 in., of which about 24 in. would have protruded from the gum. The canine tusks of the female are proportionately shorter. The longest pair of female tusks obtained did not exeeed 20 in. in length. In the Pacific Ocean, however, the walrus is said to develop even longer tusks than those above recorded.

Unlike the seals and the sea lions, the walrus has proportionately a very small eye. The upper lip is very much developed and is set with forward-directed bristles, which are a marked feature in the creature's countenance. These exaggerated vibrissæ are as thick as crowquills. The upper lip is divided into two great lobes by the vertical groove below the nostrils. These vibrissæ, answering to the cat's "whiskers," are thick, coarse, and very numerous in all the seals, but in none of them are they developed to such an extent as in the walrus. They would almost seem to act like the whalebone of the whale—a sieve through which the molluscs, sandworms, and star-fishes can be strained free of inedible matter. The great tusks seem to be used for digging into sand and mud in order to rake up bivalve molluscs, crustaceans, and other shore-frequenting creatures on which the walrus feeds. The rounded molars are useful for crushing shells, which are then ejected from the mouth whilst the tongue feels for and retains the soft parts from which the shells have been removed. No doubt the walrus also eats small fish, but it is questionable whether the remains of seaweed found in the stomach have not been introduced accidentally in association with the shell-fish. There seems to be little doubt that the walrus also makes use of its long tusks for hoisting itself up on to ice or on to rocks, and for aiding its progress on land when it is in a hurry. They are certainly used as weapons of offence in defending itself against the polar bear or man and in fighting among the males at pairing-time.

The walrus is a very big creature, adult males measuring from 10 ft. to 15 ft. in length from the snout to the tip of the small tail, and it is said that the largest recorded adult male weighed nearly 3,000 lb. In the adult the hide is nearly hairless in parts except along the neck. The skin in adults is thrown into a number of folds and wrinkles, especially about the shoulders. Young walruses have the body thickly covered with fine short hair. In the upper parts of the body the hair is yellowish-brown, which deepens into chestnut on the limbs and belly. The breeding season of these animals is from April to

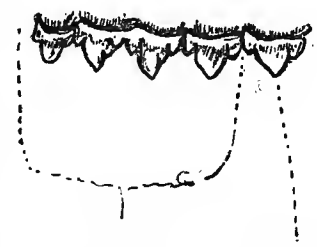
June, according to latitude. The period of gestation is about a year, and the female walrus is said to breed only once in every three years. The mammæ are two in number ordinarily, and are situated on the abdomen.

An extinct form of walrus (*Odobænus huxleyi*) inhabited Eastern England at the close of the Pliocene period, and the True Walrus (*Odobænus rosmarus*) was found in the same region (Ely fens and off the coast of Suffolk) during the human epoch, but it was also known on the coast of Scotland perhaps as late as the fifteenth century. Much later than that, within the first half of the nineteenth century, walruses have been killed on the coasts of the Hebrides and of the Orkney Islands. It was reported that one was seen off the coast of Orkney in 1857, and another about the same time in the Shetland Archipelago. Two or three centuries ago the walrus was still abundant off the coast of Norway, and was very common round the coasts of Iceland, while in the North Pacific between latitude 55° and the polar ice it was extremely abundant down to about thirty years ago. The walrus, however, is fast being exterminated by man. Mr. Lydekker states that in ten years, between 1870 and 1880, at least 100,000 walruses must have been killed by the Russian whalers, who exported from the vicinity of Behring Straits 400,000 lb. of walrus ivory and 2,000,000 galls. of walrus oil during that period. At the present day the walrus is found round the northern coast of Greenland and the north-western shores of Hudson's Bay and Baffin's Bay. At one time they ranged southwards as far as Newfoundland, but have been extinguished near all the habitable parts of British North America since 1840. East of Greenland the walrus is met with occasionally off the coasts of Iceland, Spitzbergen, Franz Josef's Land, Novaia Zemlia, and eastwards along the north coast of Siberia as far as the estuary of the Lena. The Pacific variety of the walrus is still found along the north-east coast of Siberia, the chain of islands across Behring Straits, and the northern and north-western coasts of Alaska. Its days are numbered, because neither the British Government, nor the Russian, nor the Danish, nor that

of the United States, as Governments, care one particle about zoology, or the saving from extinction of remarkable mammals which can be slaughtered for "sport" or commerce.

Family: *PHOCIDÆ.* THE TRUE SEALS

The Phocidæ are a little less specialised in their teeth than the sea lions and walruses. The upper incisors are not grooved as they are in the Otariids, and the premolar teeth are proportionately larger and have longer cusps. Both the hind and fore feet are also less specialised than in the other two groups. In the case of the fore feet of the True Seals, though the first finger is the longest, the rest are more nearly equal to it in length than is the case with the elongated flipper of the sea lions and walruses; in fact, it is more like the normal paw of a land Carnivore; there is more outer distinction between the toes, the web does not protrude beyond the tips of the claws, and the claws are in most seals very well developed, almost like the claws of a bear. The hind flipper has the same feature as in the other two families, of the fifth and first toes exceeding the other three inner ones in length and thickness, but the lobes do not extend appreciably beyond the nails on the five toes. On the other hand, in the True Seals the hind feet cannot be brought forwards as in ordinary mammalian progression; they are always turned back, and more or less closely adpressed against the short, stumpy external tail; in fact, the hind limbs of the True Seals now serve just the same purpose as the flukes of a whale's tail.



PREMOLARS AND MOLAR, UPPER JAW, OF COMMON SEAL.

In the following points the True Seals are more specialised than the sea lions and walruses: they have no outer conch to the ear, and the nostrils open upwards, are placed, that is to say, on the dorsal surface of the nose. The neck is very short, and the True Seal's body is obviously more suited for existence in the water than on shore. Owing to the impossibility of using the

hind limbs for locomotion on land, the True Seals cannot travel very far from the water's edge. Such progress as is made over the rocks or on ice or sand is by wriggling the body in a serpentine course, occasionally using the fore limbs to grasp uneven surfaces, pushing them forward alternately. When landing on rocks or on ice they raise their bodies nearly erect, and hoist themselves up out of the water by means of their fore limbs. In spite of these disadvantages seals manage to accomplish considerable distances during the night (they rarely travel in the daytime) on land.

In the skull of the True Seals there is no alisphenoid canal, and the angle of the lower jaw lacks that inflection characteristic of the Otariids, the Creodonts, and the Marsupials. The testes never descend from the abdomen into a scrotum, and the palms and soles of the feet are hairy, and not naked or warty as in the sea lions and walrus. There is no woolly under-fur as in the sea lions (who are the "fur" seals of commerce), but the skin of nearly all True Seals is covered with stiff, shiny closely-pressed hair, and this coat is nearly always more or less marked with spots or blotches of dark on light. In this spotted nature of their coat the True Seals differ markedly from the sea lions and the walrus, both of which groups are absolutely one-coloured. Seals generally possess two pairs of mammæ on the abdomen. The young are invariably brought forth on the land, and have to be taught to swim by their parents. They take to the water with some reluctance.

True Seals are polygamous, but do not have such a strongly marked rutting season as is the case amongst the sea lions (a period of something like three months, in which the male almost entirely abstains from food). They are, however, equally gregarious.

Sub-Family: *PHOCINÆ*. THE COMMON SEALS

In this sub-family the incisor teeth number three pairs in the upper jaw and two pairs in the lower. There are five well-developed claws on all four feet. In the hind limbs the first toe

is longest, then the second. The third and fourth are shortest, and the fifth is nearly as long as the second. Although the general aspect of the hinder feet is to show a preponderance of length on the part of the first and fifth toes, still this is nothing like as much exaggerated as in the other sub-families of the True Seals or as in the sea lions. As already remarked, the fore paws (especially in this group) are much more similar in appearance to those of the terrestrial Carnivora, though the first finger is the longest.

Phoca vitulina. The Common Seal

The three last premolars and the molar teeth in the jaws of the Common Seal and other allied members of the genus Phoca are double-rooted. The head is round and short, and the eyes very large. The aperture of the ear is not far behind the eye, and is triangular in shape. The upper lip is thick and somewhat overhanging. It is deeply scored with the parallel lines of the insertion of the vibrissæ, and these are long and abundant, as they are in most seals. As already related of this family, the aperture of the nostrils is directed backwards rather than forwards. The fore feet are short, and armed with strong, narrow, sharp claws. The claws on the hind flippers are narrow, shorter, and less curved. The adult of the common seal scarcely exceeds 5 ft., and females may show as small a measurement as 3 ft. The neck of the common seal is rather short.

The coloration varies much in individuals and according to age. The young at birth is covered with a coat of thick, soft fur, lemon-white in tint. In the species under review this woolly coat is shed by the infant seal a few hours after its birth. In some cases this woolly covering when shed seems to form a kind of mat for the young seal to lie on. When the white fur has been discarded, the bright little creature (and young seals are beautiful with their large liquid eyes) is seen to be smoothly clad with the shiny silky hair characteristic of the adult; but it is generally much more vividly spotted and streaked with dark on

light. The ground colour of the hair of the common seal may be described as a lemon-yellow inclining to a sickly white or an amber tint. Sometimes this lemon ground is almost greenish by the admixture of gray or brown hairs. On this light ground are scattered many irregular spots, bluish-black with the sheen of the hair. The hind limbs incline more to umber-brown. The strong vibrissæ are white. In some specimens the spots are very thick on the back, and are brownish. Some examples of the common seal are almost black all over. Others, again, are a greenish-yellow, with only a few black spots. The large eyes are one uniform tint of deep bluish-brown.

The number of mammæ in the common seal is four. The pairing season round the coasts of the British Islands is in September, and the single young one—occasionally two—is born in the month of June. The young of the common seal takes to the water a few hours after it is born, and as soon as the woolly coat is shed. The mother lies on her side to suckle the calf.

The common seal, like all members of this sub-order, is not a silent animal, and has considerable inflections of voice. When a number of them are massed together on the rocks out of the water, and are not alarmed, they keep up a constant grunting sound not unlike that made by pigs in a state of contentment. Occasionally this grunt rises into a snort of defiance, more of sportiveness than pugnacity. The young seal makes a constant baaing sound, especially when seeking nourishment from the mother. Adults vary their grunts with a plaintive bleat or a loud bark. In the month of September this harsh coughing or barking noise is distinctly audible on parts of the coasts of Ireland and West Scotland which seals frequent, and is no doubt uttered by males who are attracting or defending mates. Unless very much harassed by human enemies, the seal, in short, is rather a noisy creature, and seems to be fond of sound, for it is undoubtedly attracted by loud talking on the part of fishermen and by music. No doubt it has long since learnt not to inquire too closely into the ways of man, finding that

the raising of its head is a signal for a hail of bullets ; otherwise there are many stories showing that in former times seals have often approached boats out of curiosity when loud talking was going on. Music undoubtedly attracted them, and in captivity seals seem to experience the greatest delight at the playing of musical instruments. It has been related by an old writer in connection with the fauna of the Orkney Islands that the seals would swim directly to the shore when the church bells of Hoy (in Orkney) were rung. They are extremely inquisitive animals, and no doubt the unusualness of the sound attracts them as much as any pleasure in the novel vibrations in their ears. And as regards this point it is noteworthy that, although the seal is quite unprovided with any ear conch (deemed so essential to good hearing in other mammals) it is apparently most alive to gradations of sound.

Its brain case is large, the brain highly developed, and the intelligence keen. It can become attached to a human being as acutely as any dog. Indeed, in earlier times seals experienced such a desire to consort with seafaring humanity as to have attracted the attention of classical writers, and no doubt to have given rise to most of the stories of mermaids. Any foolishness of this kind has, of course, been promptly put a stop to during the last century by the unflagging use of the rifle or any stout piece of wood that came to hand.

The common seal has a somewhat valuable skin, and provides from the fat that surrounds its body a preparation of valuable oil. The flesh even is edible. Apart from all these excuses, of course it is a "wild animal." When caught on shore it is entirely at man's mercy, and when bobbing about in the water it is as good a mark for the rifle as an empty beer bottle. Apart, therefore, from any inducements to use its skin for the coats of motorists, or its oil for making soap, the joy of killing it for the sake of killing is irresistible to yachtsmen, sportsmen, and fishermen, and it is unlikely, therefore, that it will continue to exist much longer as an inhabitant of British waters. But for this craze for destruction we might have had seals all round the

sea-coasts of England, Wales, and Ireland as tame as dogs and as harmless. When our grandchildren awake to the knowledge of what they have lost, they ought to take the ashes of those ministers and permanent officials who never raised a finger to stop the destruction of British Mammalia, and scatter them abroad with every sign of loathing and contempt.

The food of the common seal consists in the main of fish, crustaceans, molluscs, starfish, sea porcupines, and occasionally sea gulls and other wildfowl.

The distribution of the common seal is practically circumpolar. It is found on the eastern and western shores of the North Atlantic, and on both coasts of the North Pacific. To the southward it reaches as far as the north coasts of the Mediterranean (where, however, it is very scarce), and on the American side as far as the coasts of New Jersey. In the Pacific it extends southwards to California on the one hand and Kamshatka on the other. It is common along the coasts of Spitzbergen and Greenland. On the Danish coast of Greenland something like 300,000 are killed annually, the Danish Government having no more regard than the British for the preservation of interesting creatures. In the waters surrounding the British Islands the common seal was a hundred years ago very abundant. It was even foolish enough once to visit Brighton within the memory of people now living. Naturally impertinences of this kind on the coasts of Hampshire, Sussex, Kent, and Essex were promptly punished, and it is probably never seen now on the English coast except off Cornwall, Northern Yorkshire, Northumberland, and Cumberland. It is still common all round the coasts of Ireland and of West and North Wales, and Northern-eastern and Western Scotland, the Orkneys, Shetlands, Hebrides, and the great islands off the coast of North Britain. It should (if our rulers had the slightest interest in unproductive science) long ago have been placed on the protected list. As it is, its destruction and that of other seals and sea lions makes an excellent subject for a Mansion House jest by modern statesmen.

Phoca grœnlandica. The Harp Seal

The Harp Seal is readily distinguished from any others by its remarkable coloration. The young is born with the usual woolly coat, which it retains for a fortnight or three weeks instead of the few hours mentioned in the case of the common seal. Its hairy covering following on the discarded wool is dark and speckled blackish on yellow-white. The next stage in colour is an increase of dark on the back (which assumes a blackish tint) and of silvery-white on the belly. From the third to the fifth year in the creature's age it assumes the adult coloration, which is very handsome. In the adult male the ground colour of the body is

The Harp Seal (*Phoca grœnlandica*).

yellowish-gray to pale yellow-white, almost with a lemon tinge. The face and muzzle from the region of the ears and brows to the upper lip and nose is blackish-brown. On the back there is a huge irregular mark of blackish-brown, which can be best realised by a reference to the accompanying illustration. This is sufficiently like a harp in shape to warrant the name of harp seal. The hind limbs are streaked and spotted with blackish-brown. The adult female, on the other hand, is pale yellow ranging from straw colour to amber, and deepening into tawny-brown on the back, with or without spots and blotches. The harp seal, when adult, may be as much as 6 ft. long, but males of ordinary size and females range from 4 ft. to 5 ft. in length. The back and top of the skull differ very much in

outline from the configuration of the head in the common seal. The nasal opening is higher up and more dorsal. The brain cavity is proportionately less in size, and the under jaw is stronger and heavier. Apparently the young of this seal are born much earlier in the year than is the case with the common seal—in the month of March. There are often two cubs at a birth, and three even are reported. This creature is almost extinct as a British Mammal, and therefore it would be a waste of space to say much regarding its habits. It is thought to have been caught in the Severn in 1836 and the Thames in 1858, and also on the coasts of Lancashire, Scotland, the Hebrides, and Galway. Its present range is the circumpolar seas and the northern coasts of the Atlantic and Pacific. It is common off the coasts of Newfoundland and Greenland. At one time half a million of these seals were killed annually off the coast of Newfoundland, and the annual yield of the Danish settlements in Greenland is something like 30,000.

Phoca hispida. The Ringed Seal

The Ringed Seal is perhaps the smallest member of the sub-family. The adult male rarely exceeds $4\frac{1}{2}$ ft. in length, and the female about 3 ft. The upper parts are brownish-gray, almost black along the medium line of the back, and the belly is whitish-gray. The face is uniform grey-brown, and the vibrissæ are brown instead of being white. The sides are marked with irregular oval rings of light gray, in the middle of which is a dark spot. It is in the shape of the skull, however, that the ringed seal is most readily distinguished. This resembles more nearly in shape the skull of the harp seal, but at the back, over the brain case, there is an enormous projecting ridge of bone. The cranial capacity is proportionately much less than in the common seal.

The ringed seal is almost extinct as a British species. A specimen was caught on the Norfolk coast in 1846, and another on the coast of Lincolnshire in 1889, and it may still visit the Hebrides. Elsewhere its range is circumpolar, including the

northern coasts of the Atlantic and Pacific Oceans. Near allies of this form inhabit the waters of Lake Baikal, in Central Asia, and of the Caspian Sea, relics of a time not far distant geologically when the Arctic Ocean communicated with these inland seas. The ringed seal was much commoner in British waters in the Pleistocene period, especially during Glacial conditions. Its fossil remains have been found off the coasts of England and Scotland, and in great abundance in Belgium.

Phoca barbata. The Bearded Seal

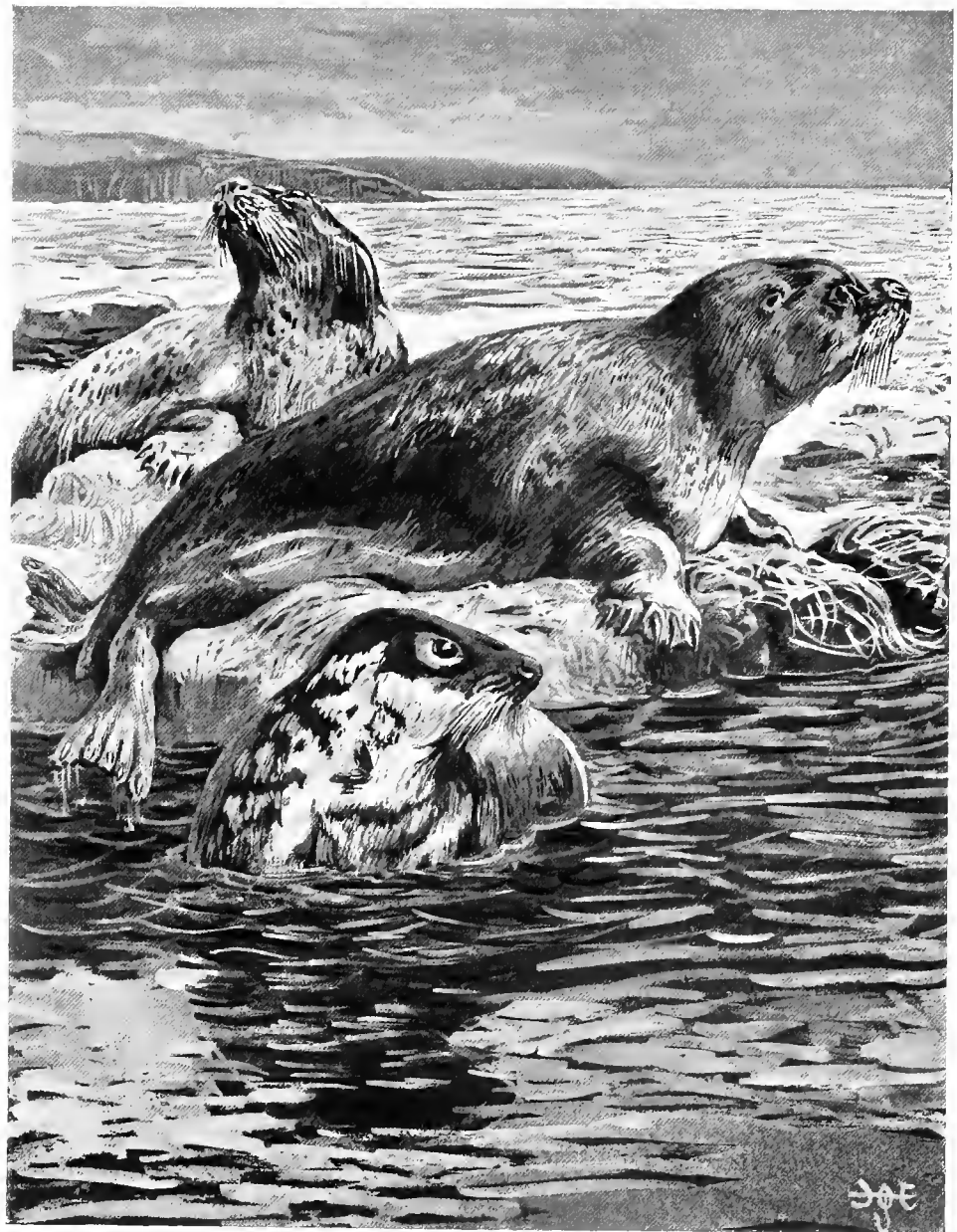
This is a large Phocine, almost the largest member of the sub-family, unless it is exceeded by the gray seal, a creature for which it is sometimes mistaken. It differs markedly from the other True Seals in its large muzzle, high forehead, and small and weak teeth, among which the canines are not much larger than the incisors or premolars. Some of these fall out in the adult, and the Bearded Seal is evidently on its way (if man does not exterminate it) towards becoming a toothless mammal. A curious feature in its fore paws is that the third, or middle, finger is longer than the rest. In this point, therefore, the bearded seal is less specialised than the other members of the sub-order. Full-grown males are from 10 ft. to 11 ft. in length, and the females over 7 ft. The colour of the bearded seal is dark gray on the back and flanks and light yellowish-gray on the under parts. The considerable development of vibrissæ gives the creature the name of the bearded seal. The present distribution of this Phocine is circumpolar and North Atlantic. On the Atlantic coast it does not extend farther south than Labrador. It is abundant on the coasts of Greenland, is met with round Iceland, and on the north coast of Norway. It is doubtful whether it has been recorded recently within British waters, though its existence was rumoured in the middle of the nineteenth century off the Hebrides. The reason it is mentioned in this book is that its fossil remains occur in the late Pleistocene deposits of Norfolk.

GENUS: *HALICHŒRUS*

Halichœrus grypus. THE GRAY SEAL

This is a larger seal than the other members of the Phocine sub-family, and it is the only other species besides the common seal which can be with any emphasis regarded as a British mammal. It is not very clear that the differences between the Gray Seal and the rest of the Phocinæ are of generic importance. The distinctions are based on the configuration of the premolar and molar teeth. These, instead of being provided with two or more cusps in addition to the central cone, are much simplified and reduced to conical compressed crowns. Occasionally the molars in the lower jaw have small hinder accessory cusps. Moreover, three at least of the premolars in each jaw are only single-rooted, and not double. It is, of course, an instance of degeneration and simplification of structure, the molar teeth in the gray seal becoming like those in the whales—simple pointed crowns like the canines and incisors.

The length of the adult male of the gray seal may be nearly as much as 11 ft., though the measurement of the females scarcely reaches 7 ft. 6 in. The average male is perhaps between 9 ft. and 10 ft. in length. The colour varies a great deal according to age and individuals. The young is at first a lemon-white in tint, and this woolly coat is retained for perhaps as long as six weeks. The young gray seal then becomes in the main yellowish-white on the under surface, and is heavily marked with quite a dark blackish-brown above. In fact, its coloration is almost black and white, the black being distributed in splotches and spots and streaks on a white ground. The top of the head and the region round the ear, the ridge of the nose and the upper part of the muzzle, are blackish, with a white spot round the eye. The flippers are marked with black spots. Some of the white parts in the young seal are tinged with yellow. Gradually as age increases the white or yellow parts of the fur darken into brownish-gray, while the black marks fade into sooty brown, until at last the whole aspect of the creature is grayish-



From a drawing by the Author.

THE GRAY SEAL (*Halichærus grypus*).

Adult and young.

To face p. 204.

brown, with a tendency to lighter coloration on the belly, and more distinctness of spots and splotches on the flanks and flippers. In the adult animals, when the fur has dried in the sun, there is a uniform silvery-gray sheen, which justifies the animal's title of gray seal. When this is seen, however, against the light or from underneath it becomes a deep umber-brown. In some individuals, however, the spots and streaks of the original markings are more distinct than in others.

The breeding-time of the gray seal is very different from that of the common seal. Breeding would seem to take place in February, and the birth of the young in the autumn—September, October, and November. The young of the gray seal is generally born in caverns or sheltered crannies, and not on open rocks or beaches. It is this species that chiefly frequents the celebrated seal caves of Achill Island off the west coast of Ireland. The large-eyed, lemon-coloured cubs (seldom more than one at a birth) take to the water with seeming reluctance, and apparently have to be taught to swim by their mothers. They do not finally adopt a water life until about six or seven weeks after birth, by which time they have shed the first woolly covering. This want of precocity in the young (which, however, may be a more generalised feature in the gray seal) makes the species much more liable to extermination by man. The mother seal is constantly with her offspring during this period of cave-dwelling, and will fiercely attack any one who may attempt to capture her cub, but her efforts, of course, are futile against rifles and clubs. The mother seal remains out of the water with her cub during the first few weeks after its birth, but when she resumes her life in the sea she generally comes on shore to suckle the cub every high tide. Whilst the cub is left on shore amongst the boulders, in some sheltered retreat or cavern, it is very silent, and its lemon-white colour, broken only by the large black eye, is curiously protective, as it resembles the whitened boulders that lie about in all directions, spotted by occasional dark purple anemones or drilled with round holes.

Gray seals are ordinarily very noisy, and make a regular

howling at times, like dogs. Owing to its much less proportionate cranial capacity the gray seal is a dull and sulky creature as compared with the common seal. In confinement it is morose and ill-tempered.

When undisturbed by man it is fond of leaving the water in the summer-time and basking for hours in the warm sunshine. At intervals it stretches its muscles in a peculiar way by turning the head backwards, and curving the hind flippers upwards till it almost assumes the form of a flattened crescent. It is very cautious nowadays about landing, and swims backwards and forwards with its head high up out of the water. The creature when pursued on shore gets over the ground a great deal faster (for a short distance) than a man can walk, and helps itself alternately with its fore paws, pressing them hard against the surface of the ground to propel the body forwards.

The gray seal is now limited in its British distribution to the south, west, and north coasts of Ireland, the coasts of the Hebrides, and the great islands to the west of Scotland, the Orkneys, Shetlands, and here and there the east coast of Scotland. Very rarely it is heard of off the coasts of Norfolk, Cornwall, and Wales. The gray seal has been caught several times in the Severn in the early part of the nineteenth century, and in 1857 one was killed on the coast of the Isle of Wight. In the middle of the nineteenth century living specimens were occasionally sent from the coast of Wales to the Zoological Gardens in London. Outside the British Islands the range of the gray seal appears to be limited to the coasts of Norway and Sweden, Spitzbergen, Iceland, Greenland, and North America down to Nova Scotia.

The sub-family of the *Monachinæ*, or Monk Seals, is not represented in British waters, its genera being confined to the Mediterranean, the Tropical Atlantic, and the Antarctic Ocean.

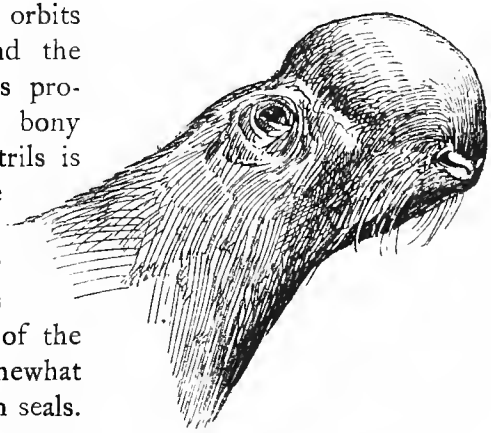
Sub-Family: *CYSTOPHORINÆ*. THE HOODED SEALS

This sub-family includes among its representatives the enormous elephant seal of the Antarctic and Pacific Oceans. The seals of this sub-family have the incisors reduced to two

pairs in the upper jaw and one pair in the lower, while the molar teeth are nearly all one-rooted, and are reduced in size and degenerate in structure. The canines are strong and stout and rather tusk-like, and the outer pair of upper incisors somewhat resemble canines, so that, however much the outer teeth may be reduced, the creature retains effective weapons in the canines and upper incisors. The first and the fifth toes in the hind feet exceed the others very much in length, and have the lobe of skin prolonged for a considerable distance beyond the nail; moreover, the claws or nails on the hind toes are either absent or rudimentary. The nose of the males is surmounted by a remarkable appendage which can be inflated at will. This, in the species represented in the British fauna, is developed into a great bladder, shaped almost like a cockscomb, but in the elephant seal it becomes a short proboscis.

Cystophora cristata. THE HOODED OR BLADDER-NOSED SEAL

The skull of this animal, to begin with, differs considerably in shape from that of the normal seal. The ramus of the under jaw is long, broad, and heavy. The ridges round the eye orbits are much developed, and the cranium, or brain case, is proportionately small. The bony partition between the nostrils is prolonged in front of the orbits in a circular form to support the huge air bladder which terminates inside the nasal opening of the skull. The neck is somewhat longer than in the common seals. The adult male has the nose bladder much more developed than the female. The bony partition in front of the eyes is continued down to the aperture of the nostrils by a cartilaginous



HEAD OF HOODED SEAL (*Cystophora*).

crest, which really forms part of the septum, or division between the air passages of the nostrils. This cartilage, added to the posterior bony wall, serves to support twin bladders divided in the middle by a groove indicating the line of the nose. These bladders can be inflated and erected at will till they somewhat resemble a policeman's helmet. When the creature is at rest the hood almost hangs down on either side over the eyes and cheeks in a series of folds.

The length of the Hooded Seal varies from 8 ft. to 12 ft. The body is long and robust. The colour in the newly-born woolly young is the usual lemon-white. When this wool is lost, their rather long hair is a grayish-yellow above and white below, and the grayish-yellow parts are marked with spots and blotches of dark gray or black. As the seal grows older the yellowish-gray of the upper parts deepens in colour into grayish-brown, which, with the black markings, gives the upper surface of the animal a hue of nearly uniform dark gray.

The voice of the hooded seal is the usual barking and whining. The young apparently are born in the month of April. The polygamous males fight very much amongst themselves in autumn during the breeding season. This seal is much more pugnacious than those hitherto described, and will not only stay to give battle to a human enemy, but will sometimes rush and shuffle towards its opponent, attempting to bite him with its canine tusks. They also attack their assailants with the fore paws, striving to overbear them and knock them to the ground preparatory to inflicting dangerous bites.

The hooded seal has been killed off the coast of Suffolk and of Eastern Scotland and in the Orkney Islands. It has also been observed off the west coast of Ireland. In former centuries its appearance off the British coasts was not uncommon, and generally attracted attention owing to the extraordinary bladder or hood. It was met with formerly off the west coast of France, but its present range seems to be limited to the Arctic regions and the coasts of Greenland, Spitzbergen, Norway, and Newfoundland.

CHAPTER X

ORDER: *RODENTIA.* RODENTS, OR GNAWING MAMMALS: HARES AND RABBITS

REFERENCE has already been made to the Rodent, or gnawing group of mammals, as having started probably in very ancient times from some generalised group of Eutherian mammal akin to the Insectivores. The marked feature in the Rodents is the complete absence of canine teeth in the upper and lower jaws, and the reduction of the incisors, which in the lower jaw are never more than two, one on each side, and in the upper jaw are equally reduced to two, except in the case of the sub-order of hares and rabbits, where the upper incisors may be three on each side in the case of young animals, and two on each side in the adult. The premolars are always below the full number, and very often either completely wanting or reduced to one each side. The feet almost invariably possess the original five toes, but differ from those of the Primates (man, apes, and lemurs) in never having the thumb or first toe opposable. The extremities of the toes and fingers are armed with claws, sometimes long and sharp, occasionally in the few large forms becoming blunt, angular, and almost hoof-like, but never developing a flat nail as in the Primates. Nearly all the Rodents have collar bones, though sometimes in a very rudimentary form. Most of them have a cæcum. The mouth is characterised by a very peculiar feature. Behind the large incisors, or gnawing teeth, of the upper and lower jaw the palate is covered with hair, so that the mouth is really divided into two portions—the entrance in front between the great incisor teeth, followed by a narrow passage more or

less thickly covered with hair, and then the larger space between the rows of molar teeth with a wet palate. The object of this division is to enable these animals to gnaw all sorts of substances with their teeth without the stuff through which they are gnawing their way reaching the interior of the mouth and being swallowed, unless, of course, it is suitable for food.

In the *Rodentia* Nature is again repeating herself, and pushing to an absolute conclusion a plan which has possibly occurred to her over and over again in the development of fishes and reptiles, and the many diverse orders of Mammalia. In the Proto-mammals, in those early groups of the Secondary Epoch which, from such slight knowledge as we possess, appear to be allied to the Monotremes, we see frequent developments of forms in which the incisor teeth are reduced in number and developed into circular tusks with a chisel-like edge, while there is an absence of canines and a diastema, or toothless space, between the exaggerated incisors and the premolars. Then, again, in the Marsupial order, one of its two divisions is distinguished from the other by a more or less Rodent-like development of the incisor teeth ; and in such a form as the wombat the resemblance to a Rodent is very striking. Among the Primates (that group to which man belongs) we have the aye-aye lemur, a creature with Rodent-like incisors, and with all the intermediate teeth absent in the adult animal. In branch after branch of Ungulates, Rodent-like conditions of teeth are developed independently and repeatedly. This is the case with the elephants, to instance only one of many examples. It is thought, indeed, by some geologists that in their remote origin the Rodents may have been connected with the primitive Ungulates. It is doubtful, however, whether this was the case any nearer in time than that in which the gnawing animals first differentiated from the primitive and generalised Eutherian stock. The point at which they did so must have been very near to the branching off of Marsupials, Insectivores, and Primates. It will be noticed in all these three groups that the first incisors to disappear are the side ones in the lower jaw: there is more persistency in the upper incisors ;

whereas in the Ungulates the tendency is rather in the opposite direction, for the lower incisors to remain and the upper to dwindle or disappear.

The Rodents are an extremely ancient group, dating back in time to the Eocene, or first period of the Tertiary Epoch. Their forms at the present day are sharply divided into two sub-orders, the *Duplicidentata*, or rodents (such as hares) with at least *two* pairs of incisors in the upper jaw, and the *Simplicidentata* (such as squirrels, porcupines, mice), with only *one* pair of incisors in the upper jaw.

The *Duplicidentata* are divided at the present day into two distinct families, one containing the pikas and the other the hares, rabbits, and a remarkable form, *Romerolagus*, which is in some respects aberrant, and in others a link between the pikas and the hares.

Family: *LAGOMYIDÆ*. THE PIKAS

These Rodents, represented by the genus *Lagomys*, are smaller than the hares and rabbits. They have short ears, no external tail, the fore and hind limbs are about equal in length, the incisor teeth are two on each side in the upper jaw, and there are premolars, either two on each side or only one. The present distribution of the *Lagomyidæ* is confined to Eastern Europe (Russia), Northern and Central Asia (from Persia to Kamshatka) and the western territories of North America (Rocky Mountains). In the Pleistocene period, however, pikas of the existing Siberian species (*Lagomys alpinus*) were found in the southern half of England in common with so many other beasts which inhabit Central Asia at the present day—gazelles, saigas, jerboas. The pika lingered on in Sardinia almost to the Historical Epoch, but apparently became extinct in Britain at a more remote period.

Family: *LEPORIDÆ*. HARES AND RABBITS

It would seem as though in our review of the origin of British Mammals we were for once to leave India as the starting-point of an important group and turn to North America.

Although the *Duplicidentata* are strongly represented in India and Central Asia, the balance of proof seems to be in favour of their having originated (perhaps with the whole of the *Rodentia*) in North America. Not only is a species of pika found still living in that continent, but on a mountain in Mexico a primitive type of rabbit-like Rodent has been recently discovered, the scientific name of which is *Romerolagus*. Lastly, hares are abundantly represented in both North and South America, and in both North and South America occurs the form of hare most nearly related to the rabbit.

The *Leporidæ* are, all things considered, the most primitive of Rodents and of the *Duplicidentata*. They possess two permanent incisors on each side of the upper jaw, and in young animals a third incisor occurs in the "milk" dentition. There are three pairs of premolars in the upper jaw, and two pairs in the lower. The molars are three pairs in both jaws, the third molar being very small. All the molars are rootless, and their crowns are marked with transverse ridges of enamel. The fore feet are five-toed, the hind limbs four-toed. The ear conch is invariably long, sometimes very long.

The hares and rabbits are now generally divided into two distinct genera, *Oryctolagus* and *Lepus*, because there are differences in structure and habits between the true hares and the common rabbit, which are thought to be of generic importance, even though one or two intermediate forms exist which it is very difficult to classify as belonging precisely to either group.

Oryctolagus cuniculus. The Common Rabbit

This creature is perhaps the only type of the genus *Oryctolagus* which, although connected by intermediate forms, differs in the following particulars from most hares of the genus *Lepus*: the longer and narrower bones of the palate, the more slender muzzle, the smaller size and capacity of the skull, the shorter ears (nearly without the hares' black tips), and the condition of the young at birth—these in the rabbit being naked and but poorly developed, while the young of hares are born with their

Photo by C. Reid.

WILD RABBITS (*Oryctolagus cuniculus*).

To face p. 212.

eyes open, fully covered with hair, and able to run about.[1] The rabbit, moreover, burrows into the ground and inhabits these burrows, whereas the typical hares live above-ground. Closely allied to the European rabbit, however, is a remarkable primitive type of Leporine, the Assam hare (*Lepus* or *Oryctolagus hispidus*), which has short ears, a fur tending in colour to the rabbit gray, and other resemblances in the skull. Also related is the South African form, *Lepus crassicaudatus*, and the *Lepus sylvilagus* of North and South America. Professor Scharff believes that the rabbit type originated in or near North America, and that its allies penetrated westwards into Central Asia, while the rabbit itself travelled eastwards across the Atlantic by a now vanished land bridge into Western Europe and Northern Africa. Many problems in the fauna of Europe and North America, and above all of the Azores, Madeira, and Canary Islands, are difficult to explain, unless we can postulate the existence during the close of the Tertiary Epoch of a land bridge across the Northern Atlantic. The equatorial isthmus which may have connected Venezuela with West Africa had probably broken down at the commencement of the Miocene period ; but a good deal of the North Atlantic bed may have risen to be dry land between North America and Western Europe by way of the Azores and Madeira. This would have been at a time when Spain was connected with the south-west of Ireland. By this route the ancestors of the rabbit must have travelled and have reached the vanished land lying to the west of Portugal now restricted to the Madeira and Azores Archipelagoes. In the Azores rabbits undoubtedly existed when the islands were first discovered by Flemish merchants. Rabbits also have been known to exist in Madeira, or in the little islands off Madeira, from the time of their discovery by the Portuguese. It has always been assumed that the Portuguese must have introduced rabbits into both archipelagoes, together with weasels and goats. Goats they certainly brought to Madeira, but it is a moot question whether the existing wild goat of the Azores may not be an indigenous wild species connected with the wild goat of

[1] There is also a difference in the structure of the cæcum.

Spain, and a relic of the days when the Azores were an outpost of Western Europe. But there is no certain evidence to prove that early in the fifteenth century the Portuguese were sufficiently interested in the rabbit or the weasel to deliberately introduce these animals into the Azores or into Madeira, directly these islands were made known. From Portugal the rabbit spread over Spain, North Africa, Corsica, and Sardinia, and no doubt from Western France or from Spain reached Ireland and England.

Into these last-named countries it is supposed to have been introduced, though there is no historical record of the Romans having done so. Since Roman times, at any rate, the rabbit has been a British mammal. It is true that no name for this animal apparently exists either in the Celtic tongues of Britain and Ireland or in Anglo-Saxon which is not derivable from the Latin name *Cuniculus*. ("Rabbit" comes from the Dutch or Flemish *robbe*, and is a relatively modern word.) The native name, however, for the wild species may have been lost, and its place taken by the Latin term applied to the domestic animal. The existence of the rabbit in these islands, as a wild creature not originally introduced by man, is a question similar to the origin of the pheasant and the existing park "wild" cattle. The ancestors of all three are considered to have been brought here by the Romans, but no historical record exists definitely proving that the Romans introduced the rabbit or the pheasant. The case of the wild cattle is more dubious. As the pheasant is found fossil in France, and the rabbit admittedly inhabits parts of that country as a wild animal at the present day, it is conceivable that both forms may have reached England without the intervention of man.

But the rabbit, though it may be indigenous to England, and perhaps to Ireland, is quite a new arrival in Scotland beyond the Lowland districts. In the Highlands it was relatively unknown seventy years ago. It seems to be pretty certain that the fossil remains of the true rabbit exist in British formations dating back to the Prehistoric and Pleistocene periods. These remains have been found in Ireland, and in Devonshire, Yorkshire, and elsewhere in England.

The general colour of the rabbit is grayish-brown, but the neck becomes, in some examples, reddish-brown. The throat and belly are white, and the outside of the ear is grayish-brown, the inside being a buff-white. There is a narrow black edging along the tip of the ear, but no decided black point like that seen in so many forms of hare. The top of the short tail is blackish, the under side, or "scut," is pure white. The upturned white tail of the rabbit when it is in flight undoubtedly serves as a signal and warning to its fellows. The wild rabbit measures in adult specimens about 16 in. from the tip of the nose to the base of the tail, and the tail is another 3 in. in length. The ears are far shorter than those of the common hare, quite two-thirds shorter proportionately. The head also is rounder and shorter, and the hind legs are not so disproportionately long as in the hares.

The rabbit is far more gregarious than the hare; in fact, it is never found singly at any season of the year, but always in large companies whose burrows form a "warren" of associated dwellings. These burrows are mainly excavated by the fore paws of the rabbit, though masses of earth are flung backwards by the hind feet. These last, indeed, constitute the rabbit's only means of offence. With them it stamps loudly when angry, and tame rabbits can deal severe blows or kicks at puppies that may try to interfere with them. In wet or marshy localities with abundant vegetation rabbits construct (more or less by their constant passage to and fro) a labyrinth of runs and galleries in the matted heather, gorse, and other vegetation, and it is said by the late Professor Thomas Bell that these runs in such localities are substituted entirely for burrows. This would seem to be correct, and if so it is an interesting instance of an earlier mode of life on the part of this member of the Hare family, with whom burrowing in the loose soil may have become a much more recently acquired habit, shared by only one other member of the group.[1]

The female rabbit, when about to give birth to young,

[1] *Lepus*, or *Oryctolagus*, *hispidus*.

excavates a separate burrow for herself with only one entrance (like that of the mole). Ordinarily, rabbit burrows are provided with an official entrance and a back door, or bolt hole. At the bottom of the breeding burrow the female prepares a nest for the reception of her naked young by pulling with her teeth mouthfuls of fur from her chest and belly. (This habit has been observed by any one who has kept tame rabbits.) In captivity the domestic rabbit is shy and nervous about her young, and, as every boy knows, may eat them at an early stage if interfered with. It is probable that this habit exists also in the wild type, though what use it can be to the species or community it is difficult to understand. It almost appears to be related to the instinctive eating of the placenta, or "after-birth," an action performed by nearly all mammals possessing teeth in whom the placenta is deciduate. The young vary in number from eight to four in normal litters, and the number of mammæ is ten. As already mentioned, young rabbits are blind and practically naked at birth. They are also very small (as compared to young hares), and bear a strong superficial resemblance to the offspring of those marsupials who produce their young in a most undeveloped condition.

Rabbits are mature and able to breed at the age of six months, if not earlier, and the number of litters in the year may be as many as four. The obvious result of this fecundity is that the increase of the rabbit when unchecked can assume such extravagant proportions as to become what the Germans would call a "world-force." Given favourable conditions, and the non-intervention of man, or the lack of sufficient carnivorous birds and beasts, and rabbits may ruin a continent by devouring all its vegetation. It is a matter of common knowledge how the introduction of the rabbit into Australia has resulted in serious damage to pastures and plantations, and how, if it had not been checked in a most expensive and elaborate manner, it might have led to the extinction of sheep and cattle, and of most of the indigenous marsupials. In a natural state of affairs the increase of the rabbit in Europe

and the British Islands would be kept in check by the proportionate increase of weasels, cats, foxes, buzzards, owls, and eagles; but when man, in his short-sightedness, exterminates these interesting beasts and birds, he must rely solely on his own efforts to keep down the devastations of rabbits and other rodents.

In Australia the rabbit shows great signs of adaptability, and will often climb trees. Instances are recorded by Thomas Bell of rabbits that have existed in hollow trees in England, and have been able, owing to the slant of the trunk, to ascend the tree for some distance. It is quite possible, therefore, that if this form developed extravagantly it might give rise to a new species or genus of arboreal habits; whilst another became more and more addicted to life underground, feeding on roots; and a third might even become semi-aquatic, for a rabbit is quite well able to swim.

In England the rabbits are somewhat nocturnal in their habits, and feed generally in the early morning and late evening, passing a good deal of the warmth of the day in the burrow, though in the winter-time they range the field by day and retire to their burrows at night.

Lepus timidus. The Mountain Hare

This is a true hare, but a little nearer to the rabbits than the form to be next described. The Mountain Hare has ears proportionately shorter than those of the common hare (*Lepus europæus*), but these ears have the customary black tip which is so marked a feature in all the hares. In size the mountain hare is slightly smaller than the common hare, its length being a little over 21 in. from the nose to the base of the tail, and the tail ($2\frac{1}{2}$ in.) is shorter than that of the common hare. On the other hand, the head of *Lepus timidus* is proportionately larger than the head of *Lepus europæus*. The two, however, differ markedly in coloration, in the contour of the head (which is rounder in the mountain hare), in the relative length of the hind legs (shorter in the mountain hare), and, as already mentioned, in the length of the ears and tail.

In the summer-time, between April and November, the woolly, soft fur of the mountain hare is fulvous-gray, the under hair being almost bluish-gray, with longer hairs on the surface that are yellowish-brown. The backs of the ears are gray and the tips are black. The belly is dirty white, and the under parts generally range between gray and white in tint. The tail is dark gray above and white beneath. In the northern parts of Scotland the mountain hare assumes the snow-white coat which this animal bears during the winter season in the Alps and the Arctic regions. Only the tips of the ears remain black. But in Ireland (the mountain hare is extinct in England) this change to complete white is never known to occur. The utmost amount of white recorded in the winter change of the mountain hare in Ireland is represented by the author's drawing, which is done from a specimen in the Natural History Museum, Dublin. In this case the face and a broad band along each side of the back remained grayish-brown, whilst the rest of the body became white. This, however, is a very rare example, and ordinarily the mountain hare in Ireland only turns a somewhat bluer gray in the winter. There are remarkable colour variations of this hare in Ireland. One of them, confined to the county of Wicklow, assumes a uniform coat of sandy yellow.

The mountain hare at the present day has its habitat in these islands reduced to Scotland and Ireland, but during the Pleistocene Epoch it equally inhabited England, where, indeed, it seems to have preceded the arrival of the common hare. Elsewhere than these islands its distribution includes Scandinavia, Northern Russia, Siberia, and Japan. It is also met with in the Pyrenees, the Alps, and the Caucasus, possibly also in the Carpathians. In Northern America it is represented by the closely allied, if not identical, "polar" hare, the distribution of which scarcely extends farther south than Canada.

The mountain hare is the only type of Leporine found in Sweden and Norway. In the days when Linnæus endeavoured to bring zoological nomenclature into an orderly condition, fine distinctions were seldom drawn between species of animals nearly allied : consequently it never occurred to Linnæus, or those that

From an original drawing by the Author.

THE MOUNTAIN HARE (*Lepus timidus*): WINTER COAT IN WICKLOW MOUNTAINS, IRELAND.

N.B.—This is the utmost extent of white ever assumed in Ireland. Drawn from a specimen in the Royal Dublin Museum.

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worked with him, that the common hare of Germany, England, and the south of Europe was a different animal from the mountain hare. To the mountain hare, therefore, and hares in general, he gave the name of *Lepus timidus*, but it is clear that in applying this name he had his own indigenous mountain hare under contemplation. Later but more discriminating zoologists applied the adjective *europæus* to the very distinct hare of Central and Southern Europe. Then later Linnæus's specific name *timidus* was applied to the common hare, while the mountain hare, on account of its changes of colour, was called *variabilis*. Nowadays, with some difficulty, zoologists have set the matter right by retaining Linnæus's name (*timidus*) for the mountain hare, and styling the species which will be next described *europæus*.

The mountain hare agrees with the common hare in having only two broods of young in the course of the year, in limiting the number of young at a birth to five at the outside (often only two), and in producing these young in a much more advanced state of development than is the case with the rabbit, as they are born covered with hair, with eyes open, and almost able to follow their mother two days after birth. The number of mammæ in this and the common hare is five pairs.

The mountain hare generally produces its young under the shelter of an overarching tree trunk or root, or in a cranny or sheltered crevice in the rocks.

Its "form," or resting-place to which it resorts, is usually between stones or on easily reached ledges of rock. In summer-time it eats grass, leaves, roots, and bark ; during the winter, bark, pines, and other seeds, and even lichens and moss.

Lepus europæus. The Common Hare

The Common Hare measures in adult male specimens about 21¼ in. from the tip of the nose to the base of the tail ; and the tail is about another 3¼ in. long. The ears are about 4¼ in. in length, markedly longer than the head. They are rather tapering towards the tip, which is black. The inside of the ear is somewhat naked. The tail is more developed than in the mountain

species, and the hind legs are proportionately much longer than the fore limbs. As in the rabbit and the mountain hare, the soles of the feet are completely covered with hair. Noteworthy in hares and rabbits is the deeply marked cleft in the upper lip. In colour the common hare tends to be much redder than the mountain form or than the rabbit. The throat and chest are a warm buff, which changes into white on the belly. The tail is black above and white below. The ears are buff-coloured at the back, with a black tip. The face is reddish-fawn-colour on the cheeks and round the eyes, while the forehead and nose are a dark blackish-brown. The hind and fore limbs are reddish-yellow. The whole of the rest of the upper parts of the body is yellowish in the under-wool, varied by the longer hairs which lie on the surface, and these are generally gray in their lower half and black for the rest of the length, so that the upper surface of the hare's body appears grizzled ("pepper and salt"), with a warm yellow-red in the clefts of the soft coat.

Hares breed when a year old. The female goes with young about thirty days, and then produces from two to five leverets at a birth. These, as already stated, are born in an advanced condition of development, with open eyes and covered with hair, and practically able to run from the day of their birth. There is no more beautiful object amongst the wild mammals of Britain than the leveret of a few days old. Its large eyes are a deep blue-gray. The ears are shorter and broader than in the adult, and the fur is perhaps a little redder in tone. These sweet little creatures in their timidity squat with their limbs and ears closely adpressed to the body. They are a warm, fluffy handful which it is irresistible to slip into one's pocket. Hares are readily tamed, and their ways as domestic pets are so charming and full of intelligence that it is surprising they are not more often kept; but it would seem as if there were a very great difficulty in inducing hares to breed in captivity, which is perhaps the reason why they have never become domesticated like the rabbit. Large breeds of rabbits, on the Continent especially, often assume, when domesticated, a hare-like

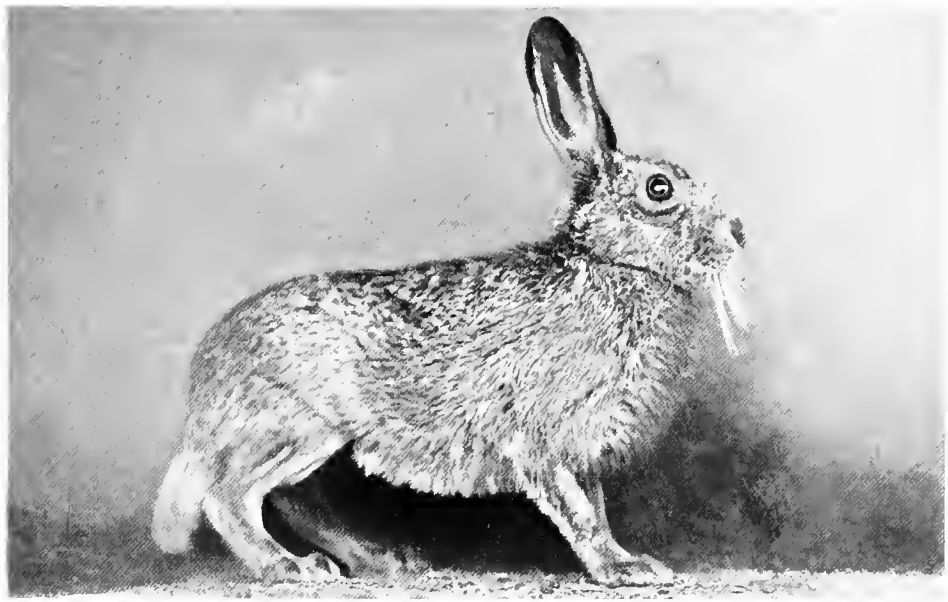

Photo by W. P. Dando, F.Z.S.

THE COMMON HARE (*Lepus europæus*).

Photo by C. Reid.

THE EUROPEAN BEAVER (*Castor fiber*).

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aspect, and this is sometimes attributed to hybrids between the hare and the rabbit; but as a matter of fact these two distinct genera have never been known to breed together.

The hare is a solitary animal in comparison with the rabbit. The sexes really only meet and live in company during the breeding season, which may be March and August. (For, in spite of statements to the contrary regarding the number of broods to which the hare gives birth, it is doubtful whether under normal circumstances this creature breeds more than twice a year.) During the month of August, however, when the grain is cut and lying in sheaves on the harvest-field, the hares flock to the feast at eventide. Not infrequently the little companies consist of a mother and her grown-up offspring. The author has taken advantage of this circumstance in his painting to illustrate a number of attitudes which the hare assumes, but it must be distinctly understood that the composition of the painting is not to imply that under ordinary circumstances hares congregate together as do rabbits.

The hare commonly feeds in the evening, and also perhaps in the early morning. In the daytime and during the latter part of the night it retires to its "form." This is a smooth oblong space generally in a slight depression between banks of vegetation, the surface of the form being smoothed by the stamping of the animal's feet, and its lying on the thin grass and herbage, which becomes dry and flattened into hay with the pressure and warmth of the animal's body. It probably passes backwards and forwards over the spot where it intends to make its form, thus clearing a tunnel through the herbage. When an enemy passes near where the hare is lying, it usually remains squatting on its form, with ears closely pressed to the body, hoping thus to conceal itself from the eye; but if the hare is out pasturing and hears a noise, its first impulse is to sit upright with erect ears, after which it either attempts concealment by lying flat, or takes to flight in a bounding gallop,[1]

[1] Hares and rabbits never progress by moving the legs alternately. They gallop and jump, but do not walk.

in which the long hind legs play a great part. Hares are strong swimmers, and in escaping from their enemies or in pursuing their mates they do not hesitate to take to the water, though they are more timid about crossing streams with a strong current. In swimming, the rump and tail are kept above the water almost as high as the head, while the back is bent inwards.

Except that so many people who read books to-day are inhabitants of towns and better acquainted with zoological gardens than with the wild beasts of their own land, it would hardly seem necessary to describe the remarkable intelligence and agility with which the hare eludes its pursuers. Unless taken unawares it can only be caught by dogs specially bred for swiftness during countless generations. But the hare is not only swift—a very ordinary qualification—it is also remarkably intelligent in eluding and disappointing the greyhound; for it will constantly reverse its course, will "double" and start off with unchecked speed in a direction almost the reverse of the one it has been pursuing. Granted the proximity of cover, and the hare must escape again and again by this trick, but of course it is practically doomed to death when its pursuit by greyhounds has been carefully arranged on chosen ground.

The cunning and agility of the hare made a deep impression on early man, especially in Southern Europe and Africa. The hare enters into Grecian and Iranic fables, while in African folklore it is universal, and takes the place of the fox, the European emblem of astuteness and cunning. Elsewhere the hare is really the origin of "Brer Rabbit." The negro slaves imported from West Africa into the United States brought with them their beast stories and fables, in which the hare played such a prominent part. In the early days of American colonisation the white settlers called every hare a rabbit. The negroes, therefore, adopted this name for their equivalent to "Reynard the Fox."

The North Aryan word for hare is derived with some probability from a root meaning "jumper." Its name in Greek

(*Lagos*) and in Latin (*Lepus*) may have been derived from Mediterranean languages not Aryan in vocabulary.

The group of the True Hares is of almost world-wide origin, being represented by one or more species in every part of the habitable globe except Australasia. Hares are found in the equatorial regions of Sumatra and of Central Africa and in Northern Greenland ; in the southern extremity of Africa (Cape of Good Hope), in South America, North America, the Sahara Desert, the Himalayas, Japan, and Ireland. The species under review—*Lepus europæus*—is absent from Ireland, and until recently was not found in Northern Scotland. It is present (possibly through deliberate human introduction) in the island of Mull and some other large islands off the west coast of Scotland. It is very common in England and Wales, though its remains in this country are perhaps of slightly later date than the earliest traces of the mountain hare. It would seem, indeed, as though the common hare entered England with the rest of the Central European fauna, and until recently confined its range to South Britain. It is not found in Northern Russia. It is common over the whole of the rest of Europe (except Scandinavia), extending its range eastwards as far as the Caucasus and Ural Mountains.

CHAPTER XI

RODENTIA (continued). SQUIRRELS, BEAVERS, DORMICE, AND RATS

SUB-ORDER: *SIMPLICIDENTATA.* RODENTS WITH ONLY ONE PAIR OF INCISOR TEETH IN BOTH JAWS

THIS group includes by far the largest number of Rodent species, perhaps in proportion to *Duplicidentata* something like three hundred to twenty. Its most archaic representatives are the squirrels, which, except for not possessing more than a single pair of incisors on both jaws, are in some respects more generalised than the hares and rabbits. Although mainly of small size, and offering a remarkable external resemblance one to the other in the smaller forms (so that an ignorant observer might class all the *Simplicidentata* in a single family), there are nevertheless remarkable differences amongst these Rodents in the number and construction of their molar teeth, in the possession or loss of collar bones, and the grooving or non-grooving of the incisors, as also in the existence of the cæcum. They are divided into three principal groups, which are termed respectively squirrel-like (*Sciuromorpha*), rat-like (*Myomorpha*), and porcupine-like (*Hystricomorpha*). The last-named is not represented at all in the British fauna past or present, though early and existing types of porcupines once inhabited France and Germany. The other two sections are divided into a great number of distinct families, of which four are represented in the types of recent or existing British Mammals.

FAMILY: *SCIURIDÆ*. THE SQUIRRELS

The squirrels and marmots are a closely allied group exhibiting very varied modes of life. Some almost fly, and many are wholly arboreal, while others never leave the ground or burrow and live beneath its surface.

Sciurus vulgaris. THE COMMON SQUIRREL

In this charming little animal, the teeth, as in most squirrels, consist of the single pair of incisors in the upper and lower jaws, one or two pairs of premolars in the upper jaw and one pair in the lower, and three pairs of molar teeth in both jaws. The molar teeth of the squirrels are remarkable in that they present perhaps more archaic features than can be met with in other groups of Rodents, their crowns being still marked by tubercles and retaining roots (see p. 238). The incisor teeth, as is the case with so many Rodents, are stained a chestnut colour. In the hind limbs of the squirrel there are five functional toes, but in the "hands" there are only four fingers, for the thumb is marked by little else than a claw. In the toes and fingers the terminal joints are crooked, and armed with long, curved, sharp claws admirably adapted for clinging tightly to the bark of trees. The number of teats in the female varies from two to three pairs, and they are situated along the abdomen. The tail is long—indeed, nearly as long as the body. From the tip of the nose to the base of the tail an average male squirrel measures just over 8 in., while the tail from its base to the end of the bone measures 7 in. The tail is somewhat heavily plumed on either side, though the thickness of these long hairs varies according to season, being more abundant in winter than in summer. When sitting up on its hind legs in repose the tail usually coils over the back, but is always stretched out behind when it is in movement, sometimes quite straight, at other times slightly curved. The nose is rather arched, the upper lip is cleft, the eye is large and full, and the ears are rounded, wide, and of considerable size. This circular outline of the outer ear is disguised during the winter months by

remarkable plumes of hair rising to an apex, and giving the creature at this season an appearance of possessing large and pointed ears. At almost all times there are a few long hairs at the point of the squirrel's ear, but these become strengthened in November into a tuft of considerable size from half an inch to an inch long. This tuft begins to diminish in April, and in May is much reduced in size.

The changes of colour in the squirrel also vary to a remarkable degree according to season. In the winter-time the squirrel's colour is dark brownish-red on the head, along the back, and down the middle of the tail. The sides of the body are quite gray. The limbs are brownish-red with a tendency to bright chestnut. The throat, chest, belly, and inside of the limbs are white. The thick plumes along the sides of the tail are dark reddish-brown. At the end of April this winter coat begins to lose the gray sides, and in the early summer the pretty little animal is a bright chestnut-red above and white below. But as the summer advances the long hair on either side of the tail tends to become a buff colour, and it is not uncommon to meet with examples in August in which the tail is quite cream-coloured at the sides, only retaining the darker brown down the middle.

Squirrels breed once a year, in April or May. They are monogamous—that is to say, they mate in pairs—and once mated remain attached to one another for years. The nest in which the young are to be born is constructed of interlaced shreds of moss, leaves, leaf stalks, grass, and strips of bark, and is placed generally in a fork between two branches or in a hollow in the trunk. Usually it is so arranged as not to be conspicuous, and often resembles merely a thickening of the trunk when placed at the angle between two branches. The young are born in June, seldom more than four in a litter; and although able to shift for themselves in a month or six weeks, they continue to associate with their parents until the spring of the next year. When eating, the squirrel seats itself on its hind legs with the tail coiled over the back, and holds its food between the fore paws. When scrambling up or down a tree, it presses its body

Photo by C. Reid.

THE SQUIRREL (*Sciurus vulgaris*).

Photo by T. A. Metcalfe.

THE COMMON DORMOUSE (*Muscardinus avellanarius*).

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against the trunk and moves the limbs alternately and independently. When on the ground, however, it progresses by a series of short bounds, and does not walk. It takes bold leaps from branch to branch, foreshadowing distinctly in this movement the specialisation of allied genera and families, some of which develop a regular parachute expansion of skin between the limbs. The broad plumed tail of the squirrel undoubtedly assists this flight through the air, in which the limbs are spread out horizontally.

The food of this pretty Rodent is somewhat varied. The staple of its diet is fruit, nuts, and seeds, but the squirrel could easily, under force of circumstances, develop into a flesh-eating animal. It is certainly addicted to eating the eggs of birds, such as the wood-pigeon, thrush, or robin. It is even accused of devouring young nestlings. A favourite food during the autumn and winter is the hazel-nut. The squirrel destroys large quantities of pine-cones, and as its attitude towards mankind is very monkey-like and "cheeky," it seems to take a pleasure in attacking these pine-cones immediately over the head of one who has retired to the forest to paint or to meditate over a book. In tearing away the segments of the pine-cone to get at the pith of the interior and the seeds, the squirrel showers down these rather moist and sappy fragments on the human being beneath, accompanying this inconvenient action by spitting and swearing sounds, or else conducting this mischievous operation in profound silence, and thereby startling one all the more by raining down unexpectedly a mass of half-chewed *débris*. It also devours beech-mast, acorns, and young leaf shoots, tender bark, buds, and flowers. The sharp and pointed lower incisors easily pierce the soft rind of the young nut. When the hazel-nut is brown and hard (as it becomes in the squirrel's winter store), a circular cut is generally made right round the nut, so that the shells fall off in halves. The kernel is then taken out, and every particle of brown skin is peeled off it before the nut is devoured.

The squirrel in a really wild state lays up considerable stores of food during the autumn for its use in the winter, and these

stores are put into many hiding-places, and are not confined to a single hoard. But in the more southern parts of England, where food is fairly abundant during the winter, or where the squirrel continues to live in close proximity to towns—which proximity results in various forms of food being procurable during the winter—it seems to abandon this practice. So it is as regards hibernation. In bleak districts, with a poor food supply during the winter, the squirrel curls itself up in some sheltered hole or cranny in a tree trunk and passes into a torpid condition, only reviving when the sun shines brightly. During these spells of warmer weather in the winter it leaves its hiding-place and searches for hoarded nuts, returning to sleep again after a good meal. But in such districts as Bournemouth, where there is an abundant food supply all through the winter and the climate is mild, squirrels are as much *en évidence* during the winter-time as in the summer, especially if they can rely on human neighbours for scraps of food.

The squirrel can do considerable harm to plantations of young trees by tearing away the bark and interfering with the flow of sap, so that in this way the tops of young larches will decay and fall off; but the worst of its evil actions is almost atoned for by its beauty and fascinating ways. It has all the impudence and much of the intelligence of the monkey, whom it imitates also in its wastefulness and its chattering cries. The squirrel's voice is very varied. Sometimes it utters a series of metallic clacks, then a rapid succession of spitting squeaks. It constantly intimates in this manner, with a distinct tone of haughtiness, its impatience and annoyance (more or less affected) at the intrusion of the human visitor, whose inquiring gaze it will dodge perversely round and round the ample trunk of some tree. Yet it is as inquisitive as a monkey, and is by no means anxious to scamper off and avoid human society. Any one who has sat long sketching in a wood where squirrels are will realise that his presence affords to them a perverse attraction, due, no doubt, to their inquisitiveness. They pursue one another from branch to branch and from tree to tree with much swearing, as though

they completely ignored the presence of a stranger. Then they will affect to be excessively frightened at their audacity, and hide palpitating behind a tree-trunk, scrambling round, however, in a minute to gaze at you with their large liquid eyes and to spit and swear from their open mouth, with the points of their little brown teeth just showing. Squirrels are adorable. They should be placed in the first rank of native beasts which we have every justification for cherishing and helping to increase and multiply. There are countless stories of their charm and intelligence when they are obtained quite young and carefully tamed. It is little or no use catching them after they are grown up, as they are then untameable, and can bite very severely.

The squirrel has apparently existed in England since the Pleistocene period, and is abundant everywhere in this country and in the wooded parts of Wales. Although existing in many parts of Ireland, it is scarce there; and its presence in that distressful country, which Nature has treated so badly in the distribution of mammals, is ascribed to human introduction. In the north of England and in Scotland the existence of the squirrel seems to have been subject to vicissitudes. It was originally unknown in the Lake District, and perhaps did not exist there as far back as a hundred years ago, but it has now become fairly common in the woodlands of Cumberland and Westmoreland. The squirrel has always been known in the Lowlands of Scotland, but in the Highlands its existence has fluctuated. No doubt, as Mr. Lydekker points out, the complete disappearance of squirrels in some Scotch counties has followed frosts of unusual severity; while, of course, everywhere in this region its presence depends on whether the country is forested or quite without trees.

Outside these islands the common squirrel extends right across Europe and Asia to Japan. It is found in the north of Africa (Morocco, Algeria, and Tunis) wherever there are woods; throughout Temperate Asia, north of the Himalayas; but is absent seemingly from Italy and the Crimea. Its range on the north just about reaches the Arctic Circle. As it depends absolutely on the existence of trees, it is but little met with in

Spain and Portugal, except in the northern regions. It does not seem to have been well known to the Romans in the past, for the Latin name, *Sciurus*, is simply derived from the Greek, *Skiouros*, a combination meaning "shadow-tail." There is also, so far as I am aware, no recorded Anglo-Saxon or Celtic name. The English word at present in use is, of course, derived through Norman-French from Latin; yet, as it is pretty certain that the squirrel inhabited England continuously from the Pleistocene Epoch, the absence of any reference to it before the Norman Conquest is a negative argument in favour of the rabbit being also indigenous.

Spermophilus citillus. The Suslik [1]

This is a squirrel-like creature with a short tail, which is, no doubt, a transitional form between the squirrels and the marmots. It inhabited England during the Pleistocene period. The Suslik is represented in North America by a nearly allied form called the gopher, which has a longer tail. The susliks in both continents excavate and inhabit burrows. Both European, Asiatic, and American forms have a tendency to a flesh diet, and American gophers have become of late remarkably flesh-eating animals. This is an interesting transformation in such Rodent types as the squirrel, the suslik, and the rat, as the teeth of this order were originally developed and differentiated solely with a view to a vegetable diet.

Family: *CASTORIDÆ.* THE BEAVERS

In the Beavers there are three molars in each jaw, but there is only one pair of premolars in each jaw (as against an occasional two in the upper jaw of squirrels), and the molar teeth are rootless—a sign of specialisation. The tail is highly specialised, being long, broad, flat, and covered with entirely hairless, scaly

[1] Remains indicative of the genus *Spermophilus* have been found in the Thames Valley. It is not quite certain that these remains can be attributed to the modern form inhabiting Central Europe and Northern Asia.

skin. The short and flattened ears, which are very much concealed in the long fur, are naked and scaly, like the tail. The hind feet of the beaver are larger than the fore paws, and are webbed. A characteristic of great interest (as revealing an archaic trait in the beaver's construction) is the opening of the anal and uro-genital passages of the female into a common outlet, which, though shallow, gives the appearance externally of conditions like that of the Monotremes. The hind feet have another peculiarity, in that they carry a small additional claw on the second toe. There are five toes on both front and hind feet. The fur is composed of long, soft, fine hair, set very thickly; and the general colour is a deep chestnut or umber-brown all over the upper surface of the body and head, fading into a gray on the stomach and under parts. Beavers are large animals, measuring as much as $3\frac{1}{2}$ ft. from the tip of the nose to the end of the tail. The number of mammæ is four, and only three to four young are produced in a litter.

The habits of the beaver are so remarkable that it is one of the world's typical mammals, adorning many an ancient story of Northern Europe and North America. These creatures have developed (perhaps more in North America than in Europe) a habit of felling trees on the banks of streams so that they fall athwart the water, and by means of their trunks, boughs, and added brushwood (together with the *débris* and mud brought down by the stream) form a dam which eventually turns the rivulet into a pool. Often in the middle of this pool the "lodge," or nest, of the beaver is placed. This is reached by one or several tunnels made from the shore under the surface of the water into the nest, which is, of course, above the surface. The nest is covered by brushwood, and the interior is lined with grass. This underground passage and the surface of the nest, together with much of the work on the dams, is rendered impervious to water by mud plastered on with the beaver's fore feet. The construction of the dams is sometimes most elaborate, for after cutting down the tree or trees which are selected for the purpose, the trunks of these are stripped of boughs and cut into

separate lengths of 5 ft. or 6 ft. Then the bark is stripped off, and these round logs are rolled into position. The trees chosen for felling rarely have a greater diameter than 9 in. to 12 in. They are, of course, trees that grow close to the bank, and are probably leaning over the water. The beaver gnaws at the tree stem near the root in a circular manner, tearing out great chips with his strong incisor teeth, and so directing his attacks that the tree shall fall by its own weight into the stream, and not on to the beaver.

It has been thought by some authorities that the constant felling of these trees is (or was originally) a provision made for supplies of food, as the beaver eats bark, together with twigs, roots, and perhaps leaves. The formation of these dams may, therefore, have been originally accidental until the beaver discovered what a protection to its nest was the artificial surrounding of it by water. Their industry, however, in this direction, seems to depend a good deal on the supplies of food, and in parts of Europe (where the beaver still lingers) abundance of food away from the river banks, in the shape of corn or fruit, seems to have made it indifferent to the work of felling, building, and plastering. The beaver progresses on land by the alternate movement of its feet, not employing the jumps and bounds of the squirrel or the rabbit.

The distribution of the European beaver (*Castor fiber*) at the present day is limited to a few spots on the Rhine (where they are nearly extinct), on the Rhône (but not elsewhere in France), here and there in the Elbe Basin, especially in Bohemia, and on the Lower Danube. The beaver still lingers on some of the rivers of Western and Arctic Russia, in Poland, and on a few of the Siberian rivers. It also inhabits Norway, and it has been reported to exist on the Upper Euphrates and in the Caucasus. Except, however, on the Lower Danube and in Norway, where it is carefully protected, the European beaver is rapidly nearing extinction. The North American beaver, though closely allied to the form now being described, is made into a separate species, so that there is no need to discuss its range. So far

as the European beaver is concerned, its numerous remains, together with traditions and place-names, show that it once inhabited the greater part of Northern and Central Asia and all Europe, with the exception, perhaps, of Greece, Southern Italy, and Southern Spain.

In the British Islands the beaver existed well into the Historical period. It was finally extinguished (in Scotland) during the sixteenth century, if the *Chronicles of Hector Boece* (written in 1526) may be believed.[1] In the Gaelic of Scotland the beaver was called *Dobhar-chu*,[2] or *Water Dog*, also sometimes by another term (*Dovrān-loslithān*), *Broad-tailed Otter*. In Wales the beaver certainly existed down to the end of the twelfth century, and possibly did not finally die out for another three hundred years. The river in which these animals were most frequent, and in which they seem to have remained longest, was the considerable stream called the Teivi, or Tivy, which enters the Irish Sea in Cardigan Bay. In Welsh the beaver is generally known by the name *Afangc* (pronounced Avank), but it is true that this word is also applied, especially in modern times, to the otter. Its etymology is said to be derived from *afan* or *afon* (*a stream*), and *ci* (*a dog*). Ordinarily the otter is called *Dyfr-gi* (meaning *Water Dog*). It is also stated that *Llostlydan*, or *Broad-tail*, is the more exact appellation of the beaver in the Cymric tongue; this, at least, is the statement of Owen, the author of a Welsh dictionary; but this term bears so strong a resemblance to the Gaelic *Losleathan* (pronounced Loslithan) as to suggest the possibility (seeing the wide difference between the Gaelic and Cymric) that the Highland name has been transferred to Wales, or *vice versâ*. In England the beaver must have lingered as a living animal at least as late as the ninth century, though no doubt in the south of England it was earlier extinguished. The town of "Beverley," in Yorkshire, is only a slight softening of the

[1] See *Extinct British Mammals*, by J. E. Harting, p. 40.

[2] Pronounced *Dovar-Khu*; another name is Dovrān. Dovar, Dovrān, and the Welsh Düfr or Dyfr (English: Dover) mean water, or anything connected with water.

Anglo-Saxon words meaning beaver meadow. Beverley was founded and named about 710 A.D. Many other places in England between Yorkshire in the north and Wiltshire in the south retain names (such as Beveridge) showing that they were associated with the beaver by the early English. The Anglo-Saxon word *befer* (pronounced *bever*) has kindred forms, not only in all the other Teuton languages, but in Latin (*fiber*) and Russian (*bobr*). It would seem, indeed, as though this was the original Aryan name for the beaver which the Celts had lost.[1]

Fossil or semi-fossil bones of the beaver are found in all parts of England, from Devonshire to Yorkshire and Norfolk, dating from the early part of the Pleistocene period. Its remains, dating from the Pliocene (which is earlier still), have been found in Northern Italy. It is interesting to note that in the writings of Welsh and Scottish historians, who described the beaver and its mode of life from actual observation (in all probability), it pursued exactly the same habits of constructing a lodge in the middle of a pool, and of cutting down trees to build dams, as is related of its existing representatives to-day in Europe and America.

Like so many other British mammals, the beaver seemingly never reached Ireland. It is quite possible that its introduction into Scotland was a much later occurrence than its first invasion of England, and took place probably after the Glacial ages, by which time Ireland had become completely insulated. Nevertheless, inasmuch as the strait separating the Mull of Kintyre from the north-eastern extremity of Ireland cannot at that period have been very wide, and as the beaver is a strong swimmer, it is certainly *extraordinary* that it should not have reached Ireland and thriven in the suitable climate of that island.

Trogontherium cuvieri. The Giant Beaver

This creature was about one and a quarter times the size of the common beaver. In the structure and configuration of the skull, and in the molar teeth, it is slightly less specialised than

[1] Though they also borrowed the Anglo-Saxon *befer*.

the smaller beaver of to-day. Hitherto its remains have only been obtained from Norfolk (where it existed at the close of the Pliocene and the beginning of the Pleistocene periods), from France, Germany, and Russia.

SECTION: *MYOMORPHA.* THE RAT-LIKE RODENTS

FAMILY: *GLIRIDÆ.* THE DORMICE

Members of this group are all arboreal in habit, with long tails more or less heavily furred, though sometimes the hair on either side is long, coarse, sparse, and bristle-like. They are distinguished from the rest of the rat group by having no cæcum, and by their intestinal peculiarities. The premolars are one on each side, and the molars the usual three pairs. The molars retain their roots, but the crowns are not tuberculous; they are marked with long zigzag, parallel folds ending in loops, with flat surfaces.

Muscardinus avellanarius. THE COMMON DORMOUSE

This charming little rodent bears a strong outward resemblance to the squirrels, the likeness, however, being mainly superficial and limited to the bushy tail, the reduction of the first finger to a rudimentary form (while all five toes in the hind feet are developed), and the nut-eating habits. The length of the Dormouse is 3 in. from the tip of the nose to the root of the tail, and the tail is about $2\frac{1}{2}$ in. long, and evenly plumed with thick, short hairs. The body is round and mouse-like. The ears are also round, with a slight indication of a point. The ears are smooth and naked inside, and covered with short hair on the back. The face is rather squirrel-like, though the nose is a little more pointed. The eyes are black and prominent. The colour is a light reddish-brown, softening into yellow-white on the belly, with an outside patch of white on the throat and breast. The young of the dormouse, however, when first born are brownish-gray, with a reddish tinge on the head and sides. They do not assume the colour of the

adults until they are nearly a year old. The front paws are a little smaller than the feet, and both are rather mouse-like in shape and appearance. The soles of all four feet are well padded with broad, fleshy prominences like those of so many lemurs, so that they are able to cling, to break the shock of a jump, and to move very silently. The face of the dormouse is abundantly supplied with long vibrissæ.

It is extraordinarily agile in its movements, and suggestive of those African and Asiatic lemurs that take rapid and silent leaps through the air. The dormouse thinks nothing of a jump 6 ft. upwards as well as downwards.

It has five pairs of mammæ, and produces generally four young in a litter. These are born blind, but in a few days are able to move out of the nest. It is generally held that the dormouse breeds but once a year, in the spring, though the late Professor Bell gives instances of broods occurring in the autumn. Perhaps this double brood depends somewhat on favourable years or conditions of food supply. The dormouse would seem to be monogamous, but is often gregarious at breeding-time, or when preparing its nests for the winter hibernation. At these times a number of couples may form quite a little colony. The dormouse generally constructs its winter or its breeding nest in the thick foliage and closely set twigs of a high hedge or a nut-bush, not generally much higher than 3 ft. or 4 ft. above the ground. The winter, or hibernating, nest is sometimes actually put together on the ground between withered stems of grass or of short vegetation. The nests may be as much as 8 in. in diameter, and are generally constructed of blades of grass, or long stems of leaves, carefully interwoven, and offering no visible aperture. The dormouse very frequently utilises a discarded bird's nest if situated conveniently in a low coppice.

The dormouse grows extremely fat by the end of October, and about that time curls itself up into its nest and commences its hibernating sleep. Packed into the nest are supplies of hazel-nuts ; and if there is an unusually warm day in December or February, or in any of the winter months, the dormouse awakes,

eats a little food, and resumes its sleep, which may last until it emerges in April for its active summer life. Breeding generally takes place in April, and the young are born in May.

The food of the dormouse consists, during the late summer and autumn, of hazel-nuts and acorns. Earlier in the summer it eats corn and any other kind of grain, and the seeds of a good many plants, together with leaf and flower buds, many small grubs, caterpillars, weevils, and other insects, and the eggs of small birds, besides such wild fruits as it can obtain. Though almost the shyest of British Rodents, and never liking to force itself on man's attention as does the squirrel, it is nevertheless the most easily tamed of all of them, and makes such a charming and cleanly pet that one wonders not to see it more often kept in captivity.

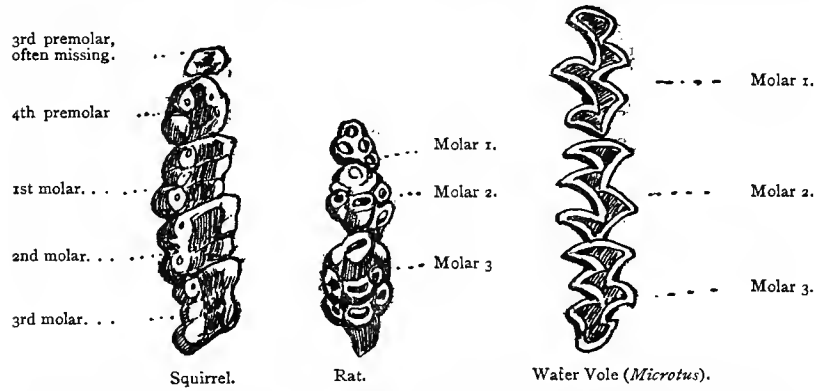
The common dormouse is found fairly abundantly in the south and centre of England, and in the south of Wales. Its distribution in the north of England is apparently confined to the wooded parts of Western Lancashire and Cheshire. It has never been recorded from Scotland, though it may be found here and there in the Lowlands, and it is entirely absent from Ireland. Outside the British Islands its range extends over the greater part of Central Europe, reaching as far north as the south of Sweden and as far south as Northern Italy. Eastwards its range stretches into the western districts of Russia, but it does not appear to be an inhabitant of any part of Asia. In seeking for information about its distribution, care must be taken not to confuse it with allied forms belonging to the genus *Myoxus*, the larger and handsomer dormouse of Southern and Central Europe, which, however, never seems to have reached England in its distribution. This dormouse of the genus *Myoxus* can be traced back geologically to the Eocene period! One of these species of extinct dormouse developed in the island of Malta into a very large size, comparatively, becoming bigger than a guinea-pig. This giant dormouse, curiously enough, shared the island of Malta in the Pleistocene period with elephants and hippopotamuses

which had shrunk to pygmy forms, the elephants no larger than sheep and the hippopotamus the size of a small pig.

The dormouse, strange to say, does not seem to have been of Asiatic orgin, but to have originated in Africa, where three genera are represented at the present day. The range of the family at present extends from South Africa to Southern Sweden, and from West Africa to Little Russia.

FAMILY: *MURIDÆ.* THE RATS AND MICE

The *Muridæ* differ from the Rodents hitherto described in being still further specialised. Their teeth, besides the single



MOLAR TEETH OF SQUIRREL, RAT, AND WATER VOLE (*Microtus*) FOR COMPARISON. Twice natural size.

pair of incisors in each jaw, are reduced to only three pairs of molars above and below. They have lost the premolars. The molar teeth of the Rats are sometimes rooted and sometimes rootless. In the True Mice and their allies they are marked with rubbed-down tubercles (like little craters), which are widening out into ridges of enamel. In other forms these enamel ridges become the usual zigzag, raised, flattened folds. The tail is nearly always hairless, with the skin covered by minute scales. The ears are large and rounded. There are five toes on all four feet, but the first finger (equivalent to our thumb) on the fore feet is rudimentary, and reduced to little more than a nail. It is noteworthy that the thumb should be marked in the True Rats and Mice by a short nail instead of a long claw.

Mus decumanus. THE BROWN RAT

This creature is almost an unmitigated pest, and *is one of the few mammals that it would be virtuous to completely extinguish.* It is almost the largest form amongst the True Mice, measuring when fully grown about 9 in. from the tip of the nose to the root of the tail, and over 7 in. in addition along the tail to its extremity. Its head is very long, as compared with other mice, and is furnished with a powerful lower jaw. The snout is ugly, and nearly naked. The black eyes are very prominent, seeming almost to bulge from the head, and not being sheltered within any marked cavity in the brows. The ears are round, large, and set well back. The mouth opens far behind the snout, and the cleft upper lip is consequently long. The general colour is grayish or umber-brown, darkened here and there by the presence of long hairs that are blackish in colour. On the under surface it is gray. The tail is flesh-colour, with the small scales set in overlapping rings. On the coasts of Ireland this rat sometimes develops a black variety with a whitish patch on the chest. The prominent eyes, the long, blunt snout, the scaly tail, the dingy brown colour, and the savage disposition of this rat, combine to make it a repulsive creature. It is said to be cleanly in its habits, though it frequents the filthiest adjuncts of humanity.

The Brown Rat, like some other members of the genus *Mus*, has six pairs of mammæ,[1] and is exceedingly prolific. It breeds as often as four times a year, and the litter may contain from eight to fourteen young ones. The female rat can breed before she is fully grown, at six months old. As regards food, they are omnivorous, and will eat flesh as greedily as parchment, leather, grass, seaweed, shell-fish, corn, roots, bones, ivory, fruit, sewage, and fish. The rat's carnivorous propensities leads it to attack, kill, and devour birds and all the smaller mammalia with which it may come into contact, and even man himself. Snakes and

[1] According to Owen. Some zoologists reduce the number to five pairs. There is quite possibly local variation.

insects which it might attack and destroy with some benefit to humanity it leaves alone, and the snakes, owls, buzzards, and other predatory animals which might assist man in ridding the world of a plague of rats, are foolishly slain by humanity, instead of being most carefully protected.

The brown rat burrows easily into the ground, and uses its strong incisor teeth to gnaw its way through timber or cement. It is nocturnal in its habits when its presence abroad in the daytime might be risky. In moving about in the darkness it is undoubtedly much helped by the length of the sensitive vibrissæ which grow from the muzzle. In its home life, so to speak, it can be affectionate and even tender, yet when pressed by hunger or fear it will devour its young or its weaker comrades. It has a considerable development of voice, squeaking loudly, uttering a thin metallic "skikking" sound when angry, or a grunting, murmuring noise when amorous. It can jump to considerable heights up or down, run for miles and at great speed, and swim for considerable distances. In some districts it almost takes to a water life, so that in many English rivers and canals it is mistaken for the large water vole. Elsewhere it will resort to the trees, or it will live a life wholly subterranean.

The brown rat would appear to have originated in Central Asia, and allied forms are found in India. Some great increase in numbers, combined with the decrease of food supply, caused it to commence emigrating from Central Asia in the sixteenth and seventeenth centuries. It crossed the Volga and entered European Russia in 1727. It was brought to England by vessels coming from the Baltic about 1730, or even earlier. Paris was occupied in 1750, and now the distribution of the most odious and universally detested mammal on the face of the earth is world-wide. It is found throughout the British Islands, including not only England, Wales, Scotland, and Ireland, but even the remotest islands off these shores. British shipping has assisted unconsciously but effectively in carrying the brown rat to all parts of America, Australia, the Pacific Islands, and Africa. In remote parts of Central Africa it is

as great a pest as in India (where it carries the plague from place to place) or in England. Its universal extirpation should be made the special object of an International Congress.

Mus rattus. The Black Rat

The Black Rat is 2 in. shorter in the body than the brown rat, but the tail is proportionately longer, being $7\frac{1}{2}$ in. in length as compared with the 7 in. of the body. The tail is very tapering and curly towards the tip. In colour normal specimens are grayish-black above and pale gray below. Occasionally examples are met with that are brownish-gray, and allied forms in Egypt and Tropical Asia tend very much to reddish-gray or chestnut. The fur of the black rat is beautifully fine and soft, and when it was more plentiful the skins were of considerable value in commerce. In an allied form coming from the Andaman Islands, however, the fur actually develops spines. The black rat is the origin of tame albino or pied rats, which must have been in existence as a domesticated breed for at least a couple of hundred years. Like the brown rat, it has twelve mammæ, and breeds three or four times in the year, having a large number of young in a litter. It is almost as omnivorous as the brown rat, though perhaps from its less vigorous constitution and greater timidity it is not such a carnivorous animal. The black rat presumably originated in Western or Central Asia, and commenced the invasion of Europe and Africa at a relatively remote period (perhaps 1,500 years ago), travelling, like the brown rat, through Russia and Germany.[1] Its introduction into England may date back to the time of the Norman Conquest or earlier. It was called by the Welsh the "French mouse." After a time it inhabited the whole of Europe as far north as Lapland, and southwards into North Africa. The present writer has met with the black rat in Central Africa, in the more isolated villages where it has not yet been extirpated by its brown relation.

[1] The word "rat" is of Teutonic origin. The Romans did not distinguish this creature by any specific name. If they knew it they called it a mouse.

It was carried in ships to America in the middle of the sixteenth century, and is now found throughout the New World and the West Indies concurrently with the brown rat. In the British Islands it lingers in small numbers in parts of Ireland, Scotland, and Northern England, but has been nearly destroyed by the brown rat, which has also exterminated it in many parts of Europe.

Mus musculus. The Common Mouse

'A pretty, but annoying little pest," is the very apt definition of this commonest of Rodents given by several writers on British Zoology. The Common Mouse has nothing of the repulsiveness, or even horror, that attaches to the brown rat. It may be very annoying through the mess and litter which it makes and the damage it may do to food, but it is of engaging appearance and ways which can even be winsome. Its length from the tip of the nose to the root of the tail is about $3\frac{1}{2}$ in., and the tail is nearly as much again. It differs from the wood mouse, which is about to be described, by its smaller ears and eyes, the limbs and tail being also somewhat shorter. Its coloration is less bright, being an almost uniform grayish-brown, somewhat lighter on the belly. The singular glossiness of the fur, however, gives it the appearance of being "well groomed." It is, in fact, a very elegant little creature. There is a great tendency to variation in the common mouse, both in colour and size. Some varieties of it inhabiting islands or mountain districts are smaller than the house mouse or than those which frequent stacks and granaries. Amongst other variations of colour than albinism—and white mice seldom maintain this for long amongst their coloured brethren—there are pale gray or pale buff varieties and others in which the back is dark brown flecked with white, or dark sepia. There are long whiskers, or vibrissæ, but these are not developed quite so extravagantly as in the wood mouse.

The common mouse has large naked ears, though this feature is not so marked as in the wood mouse. The ears are rounded,

Photo by T. A. Metcalfe.

LONG-TAILED FIELD OR WOOD MOUSE (*Mus sylvaticus*).

HARVEST MOUSE (*Mus minutus*).

Photo by T. A. Metcalfe.

RED BANK VOLE (*Evotomys glareolus*).

Photo by W. J. Clarke.

BLACK RAT (*Mus rattus*).

To face p. 242.

almost horseshoe in shape. The tail is scaly, the rings of scales being interspersed with sort hairs.

It has twelve mammæ, and produces from three to five litters in the year, the young, like those of all other members of this sub-family, being born blind. Young mice are, however, able to shift for themselves at the end of a fortnight, and are fit to breed on their own account when about four months old. The common mouse is the reverse of a silent animal except when suspicious of danger. Its squeaks are varied in tone, and individuals actually develop singing powers. The present writer was incredulous at one time as to this fact, but several years ago had his attention drawn to mice that had been captured in Tunis and kept for a time in confinement, and to similar instances in England. The singing of these mice resembled the chirping, quavering notes of a young cock canary who is beginning to experiment with his voice. Mr. Lydekker states than an example of these singing mice has been heard to "run up an octave and end with a decided attempt at a trill. . . . An octave seemed to be about its range . . . and one could distinctly see the expansion of its throat and chest. Its favourite position when singing was an erect one, standing on its hind feet."

The burrowing habits, the leaps and bounds and high jumps, and the omnivorous capacity of the common mouse are too well known to be described in detail.

This little Rodent is of almost universal distribution except in the Arctic regions. Oceanic islands may only have been reached within the last hundred years, and through the agency of man. Probably the Mouse and Rat genus originated in Asia, but the common mouse was one of the first of these animals to spread over the greater part of the earth's surface which is habitable by man. It is thought that its fossil remains have been found in Pleistocene deposits and in the caves of England. It is, of course, found at the present day all over Great Britain and Ireland and everywhere else in the world except in the Arctic or Antarctic regions, the Sahara Desert, the forest regions of Africa, and the north-western parts of India.

Mus sylvaticus. The Long-tailed Field Mouse

This ofttimes very beautiful little creature (though some of its varieties are markedly prettier than others in coloration and form) is frequently confused with the common house mouse by unobservant people. It resembles the last-named mouse closely in form and shape, but the tail is proportionately longer, measuring exactly the same as the head and body. Each of these measurements is about 4 in. in average specimens. It is thus in most of its sub-species a larger animal than the common mouse. In an admirable paper on *Mus sylvaticus* and its allies (published in the *Proceedings of the Zoological Society*, April, 1900), Mr. G. E. H. Barrett Hamilton recognises nineteen sub-species or varieties of *Mus sylvaticus*, the forms at either end of this series differing widely in appearance, in colour, and in size. Of these, five inhabit different parts of Great Britain and Ireland at the present day, while osseous remains have been collected in Kent, which would seem to indicate the former existence of a sixth sub-species. The typical length of the field mouse (or wood mouse, as it is sometimes called) is, as already stated, in excess of that of the common mouse.

The preponderating number of sub-species have a handsome and well-marked coloration, which is warm reddish-brown or yellowish-gray above and pure white below, with a brown or yellow spot in the middle of the chest. The demarcation between the white of the under parts and the sandy-red of the upper is, in most varieties, very abrupt. The white of the under part includes the inside aspects of the limbs and the outer aspects of the paws, and extends across the cheeks to the tip of the nose. The under side of the tail is also pure white. The large, broad, rounded ears are hairy on the outer side and somewhat naked within, though in the inner aspect there are sparse, long hairs. The vibrissæ, or whiskers, are very long, and the eyes are particularly large and prominent. The five varieties which are found in the British Islands are named, distinguished, and distributed as follows :—

1. *Mus sylvaticus intermedius* is of medium size (the head and body about 4 in. long), but the red of the average coloration is tinged with gray, or even black, owing to many of the hairs of the back being tipped with black in the winter-time. Occasionally this sub-species becomes almost identical in colour with the common mouse. This form is distributed over Great Britain, Ireland, some of the large islands off the west coast of Scotland (but not the Hebrides), and the Channel Islands. Elsewhere it is found in Holland, Belgium, France, and Switzerland, possibly also in Western Germany and Southern Sweden.

2. *Mus sylvaticus celticus.* This is quite a small form of wood mouse, scarcely, if at all, larger than the common mouse. The tail also is not proportionately so very long, while on the other hand the ears and hind legs are longer in proportion. The colour of this form is much darker and grayer. It becomes almost black along the upper surface of the tail and the ridge of the back, while the pure white of the belly is toned to a bluish-gray. This wood mouse has rather a remarkable distribution, being confined in the United Kingdom to Southern and Western Ireland, the Hebrides, and the island of Skye. Elsewhere it exists in Northern Portugal, an interesting instance of what Dr. Scharff styles "Lusitanian" immigration.

3. *Mus sylvaticus hebridensis.* This mouse is rather a large one, but has proportionately smaller ears, bigger hind feet, and a shorter and thicker tail. The colour of the under side is less white (more gray) than in the other sub-species mentioned. The tail is uniformly brownish-gray, and there is no sharp demarcation between the sandy-gray of the upper parts and the dusky-gray of the under side. This large wood mouse is entirely confined in its distribution to the islands of Lewis and Barra, in the Outer Hebrides.

4. *Mus sylvaticus hirtensis.* This mouse is still larger than *Mus sylvaticus hebridensis*, and the under parts are quite buff-colour or yellowish-brown, the upper side being sandy-gray. In other respects, and in the proportions of the ears and feet, it resembles the mouse of the Hebrides. Its distribution is

entirely confined to the isolated island of St. Kilda, to which it is supposed to be indigenous, and a relic of the time when St. Kilda was connected with the mainland of Scotland.

5. *Mus sylvaticus wintoni.* This is the mouse described by Mr. W. E. de Winton in 1894 as *Mus flavicollis*, a sub-species (which is really the typical form of *Mus sylvaticus*) found in Scandinavia. This is a large wood mouse, about $4\frac{1}{4}$ in. in length from the snout to the base of the tail, and very brightly coloured. It has a long tail, which contains thirty vertebræ, as against twenty-seven in most of the other wood mice. Above it is a golden-brown, and below pure white. The brown spot found on the throats of so many of these wood mice is in this sub-species extended into a form like a cross, which forms a continuous band across the chest with the golden-brown of the back and sides, and a cross is formed by the upward and downward extension of this brown colour along the breast bone. This mouse was discovered by Mr. W. E. de Winton in Herefordshire, but it is also found (not very commonly) in South-east, East, and North-east England. It reappears again on the Continent in Central and Eastern Germany and Hungary, gradually merging as it proceeds eastwards into the handsomest form of all the wood mice, *Mus sylvaticus princeps*, which is found in Rumania, and which is really (for a mouse) a very beautiful little animal.

As regards the general distribution of *Mus sylvaticus* in all its forms, it may be described as fairly universal over North, Temperate, and Central Asia, the whole of Europe except the extreme north, Palestine, and North Africa. It is not found in Japan.

The wood mouse is perhaps the most prolific of all Rodents whose habits have been studied. Females will breed from the age of five months. They probably commence to breed about the beginning of March. If the food supply is good, a female wood mouse will have two litters in thirty days, the period of gestation being only three weeks. Experiments which were made and recorded by Mr. R. M. Barrington in 1881 showed

that between the beginning of March and the beginning of July one female wood mouse, at least, amongst those which he kept in captivity, had five litters, the interval between each litter being on an average twenty-five days. It is true that there were not more than five, and as few as three, in these litters, whereas the wood mouse when wild is known to have as many as nine or ten. It may be, perhaps, that the mouse in a wild state does not breed quite so frequently, but has more young at a birth. Mr. Barrington's experiment was interrupted from various causes in July, and there was nothing to show that the female which had already had five litters that year would not go on producing more into the autumn. In any case, these experiments showed that a female wood mouse under favourable conditions could in five months produce thirty-six young, the females among which would be producing litters on their own account during the summer and autumn. But for the attacks of birds of prey, owls, weasels, stoats, snakes, and such other creatures which feed on small Rodents, the wood mice would speedily devastate the crops. As it is, they are occasionally, like the smaller voles, responsible for locust-like ravages. Will it ever be brought home to the British agriculturist by the Board of Agriculture that all the above-enumerated "vermin" should be protected so as to keep down the plague of rats and mice? What harm is really done by snakes in England? *None.* What injury is done to our supplies of food by the owl, the kestrel, the sparrow hawk, the buzzard, kite, weasel, stoat, or polecat? None at all, worth mentioning. And if they do destroy a few pheasants' eggs or kill an occasional rabbit or young hare, their own existence in the country more than compensates for this modest toll by the interest and beauty which they add to the landscape.

Foxes also devour wood mice; and their nests and young (it is stated by Mr. Lydekker) are dug up by rooks and crows, who use their strong beaks for this purpose. Mr. Trevor-Battye also states that black-headed gulls pick up these mice and kill them by dropping them on the ground from a height.

The wood mouse is mainly a vegetable feeder, but will also eat

insects. In its burrows, or nests, it stores during the summer and autumn enormous quantities of food—acorns, beech-mast, ears of wheat, barley, and oats, hazel-nuts, beans, haws, and many other seeds and berries. These supplies of hidden food are so considerable that they are a great attraction to pigs when turned loose. They are smelt out and rooted up by the pig, and thus much further damage is done indirectly by the wood mouse. Wood mice very often adapt mole-runs to their purposes as burrows, but here they occasionally meet with a serious foe, for the mole greedily devours their tender young, and thinks nothing of attacking, killing, and devouring the mother mouse. Birds' nests are occupied, or regular nests of woven grass are made by the mice themselves in hedgerows, amongst wheat, or in the long grass that is ripening for hay. It is much more probable that it is to the wood mouse and its nest in the harvest-field that Burns addressed his famous lines, rather than to the harvest mouse, which is scarcely found in Scotland.[1] The wood mouse does not undergo regular hibernation, but nourishes itself during the winter from its huge supplies of stored food. Though leading a life in the country by preference, it is, in fact, the country mouse of the fable—it does not shrink at times from coming into houses, where it often displays greater boldness even than the town mouse.

Mus sylvaticus appears to be an old inhabitant of Britain, as its fossil remains can with some probability be discerned amongst the relics of the early Pleistocene Mammalia of East Anglia.

Mus minutus. The Harvest Mouse

This is the second smallest mammal in England. The length of average specimens from the tip of the nose to the root of the tail is about $2\frac{1}{2}$ in., and the tail is almost exactly the same length as the body. The tail is very lithe and mobile, and appears to be distinctly prehensile. It can be coiled twice round objects, and the tip grasps somewhat tightly. The ears are not proportionately so large as in either the house or the wood mice,

[1] "The best laid schemes o' mice and men gang aft a-gley."

and are pressed more closely to the neck. In shape and attitudes the Harvest Mouse does not differ much from the common mouse. Its coloration, however, is different, being a bright orange-brown above on all the upper parts, and white or grayish-white below. The tail and feet are flesh-colour. The warm brown of the upper parts ranges in local variations from pale yellow to chestnut, with an inclination to dark brown on the back. It is nearly as prolific in breeding as the wood mouse, and the number of young at a birth range from five to nine. The food of the harvest mouse consists of corn, seeds, grass, insects, and worms. It will eat bluebottle flies, and even bees.

One of the most interesting characteristics of this tiniest of mice is its elaborate and beautifully constructed nest in the shape of a sphere. This is built at a height of from 6 in. to 1 ft. above the ground, and is often constructed round two or more contiguous upright stems of corn or grass. This ball of finely plaited leaf blades, or of the panicles of roots or similar stems and straws carefully shredded to the necessary degree of fineness by the mouse's teeth, is sometimes without a visible aperture, the probability being that the weaving of the plaited vegetation of the elastic grass blades admits of the mouse passing in and out, while the gap closes up behind. As the young grow, which they do very rapidly, the soft, smooth interior of the ball becomes filled up with them, so that it would be impossible for the mother to get into the nest. It is difficult, therefore, to see how she can give nourishment to the young, unless, as has been supposed by some, she straddles over the outer surface, while the young push their noses through the plaited framework, and thus get at the teats. Later on, no doubt, the young issue through the interstices one by one, and are suckled outside the nest.

In winter-time the harvest mouse generally retires to burrows in the ground.

Its distribution in our country is entirely confined to England and a small portion of Eastern and Lowland Scotland. It seems to be absent from Ireland, such exceptions as are mentioned referring probably to the young of the wood mouse. It has not

even been recorded in Wales, or anywhere to the west of the counties of Gloucester and Warwick. It is very scarce in the north of England, but ranges from Devonshire to Nottingham and Lincoln, and reappears again in Eastern and Southern Scotland, ranging as far north as Aberdeenshire. Its distribution is, however, very patchy, and a great deal more might be known about this smallest mouse in regard to its habits and distribution. Outside England its range extends over France, Northern Italy, Central Europe, Scandinavia, Russia, and Siberia.

Sub-Family: *MICROTINÆ.* THE VOLES

The sub-family, which includes the voles and lemmings, differs from the mice and rats in possessing short ears and an abbreviated, hairy tail. These animals are stouter and clumsier than the rats and mice. They also have the molar teeth (three pairs in each jaw) imperfectly rooted, or rootless, and very remarkable in shape and structure, having a shape and a surface pattern which can only be expressed by the diagram given on p. 238.

The Microtine sub-family includes not only the voles, but their near ally, the musquash, or North American water rat, and the lemmings.

Microtus agrestis. The Short-tailed Field Vole

This animal is about the size of a house mouse, with perhaps a slightly larger, though shorter and stumpier, body, measuring a little over 4 in. in length from the tip of the nose to the root of the tail. The tail is another $1\frac{1}{4}$ in. or less. It can be at once told from the True Mice by the far blunter head. The eyes, also, are not quite so prominent and projecting. The ears are relatively small, are set close to the head, and are a good deal covered by the thick hair of the cheeks and neck. The soles of the hind feet develop six naked pads. The colour of the upper parts is brown, and of the lower grayish-white or ash-colour, the demarcation between the two tints being quite distinct. The tail is covered with short hair, and not with scales as in the True Mice.

Photo by C. Reid.

BROWN RAT (*Mus decumanus*).

Photo by C. Reid.

SHORT-TAILED FIELD VOLE (*Microtus agrestis*).

To face p. 250.

The fecundity of the Field Vole in favourable seasons is so remarkable that it constitutes a plague seriously affecting human interests. In normal seasons this Rodent has as many as four broods in the year between March and October, and each brood contains from four to six young. A closely allied species on the Continent may produce six different litters in a single season, some of these litters containing as many as eight offspring. A mild winter is necessary as a precedent to one of those special outbursts of fecundity which suddenly people districts of Scotland, England, and Germany with hundreds of thousands of field voles. Without the intervention of man it is probable that this rapid increase of a Rodent would receive counter-checks in many directions, but would nevertheless profoundly affect the development of other animals. In the first place it has been noticed that one of these gigantic swarms of field voles will so exhaust all the vegetable food within its residential area that a large proportion of its members will die of starvation or will engender some microbe of disease that diminishes the swarm by half. Then it would lead to the proportionate increase and prosperity of owls, hawks, buzzards, weasels, stoats, crows, ravens, and foxes, so that the uninteresting and unpicturesque little vole might be the means of adding hugely to the attractiveness of the local fauna by encouraging these scarcer, larger, handsomer, and more interesting beasts and birds. But man generally steps in and destroys the voles by poison and traps, and with equal zest destroys the owls, crows, hawks, and weasels that have been endeavouring to abate the plague, and the presence of which would have rendered the country so much more attractive to the eye. The extravagant increase of field voles in Scotland or England (the animal is not found in Ireland) has never reached to the dimensions of the same plague in Germany, but it is calculated that occasionally on the borderlands of Scotland and England (about the Cheviots), or in former centuries in Essex, the field vole has suddenly appeared "swarming in millions." On these occasions they may kill a thousand birch trees in one district through gnawing away their bark, or they may cause many sheep

to die in Yorkshire and Lowland Scotland (and anciently in the east of England) by destroying the turf. They will kill heather by barking it or nipping off the young shoots. In one part of Teviot Dale in 1891 15,000 acres of pasture were rendered useless by voles. In Germany it has been recorded that over a million and a half of these field voles were caught in fourteen days. In 1872 and 1878 the harvests of Brandenburg and of Central Germany were practically ruined by this plague.

The food of this animal is almost every vegetable substance, though they will also eat a few insects. They do especial damage to gardens and plantations, their passion for eating and peeling bark and nipping off buds being disastrous to saplings and young trees. Grass is eaten down to the very roots, and thus turf is for all time absolutely destroyed in pasture lands. Scotch farmers and graziers are deserving of no pity whatsoever for the losses they have suffered, because this plague is entirely due to their gleeful extermination of birds and beasts of prey who would be content to feed mainly, if not entirely, on voles if they were left unharassed.

The distribution of this harmful, and rather ugly, little Rodent is in this kingdom confined entirely to England, Wales, and Scotland, with the exception of the island of Lewis (Hebrides). It is quite unknown in Ireland. Elsewhere it ranges over the greater part of Northern and Central Europe, but apparently does not extend into Asia or the regions bordering the Mediterranean. In England it has seemingly existed since the Pleistocene period. In the south of Europe at the present day it is replaced by an allied species, *Microtus arvalis*, which differs from it in little else than the structure of the second upper molar tooth. Curiously enough, this southern field vole inhabited at any rate the east of England at the beginning of the Pleistocene period before the Glacial ages. It is possibly the ancestor of *Microtus agrestis*.

Microtus amphibius. The Water Vole

This is a much larger animal than the preceding species, a fine male specimen being nearly 8½ in. long from the tip of

the nose to the root of the tail, while the somewhat long tail measures another 4½ in. The fore feet, as usual, have only four complete toes, the thumb being merely marked by a claw. The hind feet have five complete and somewhat long toes with just the commencement of a webbing. The tail is thickly haired, especially on the under side. The body is densely covered with long, fine, silky hair, exquisitely soft, and very impermeable to water. When the creature is under water the tips of the fine hairs are hung with innumerable minute air bubbles, which give it quite a gray appearance. The ears are very short, set close to the head, and almost concealed in long, silky hair. The eyes are small and deep-set. The incisor teeth are very distinct from that of the other voles, in that they are deep orange or chestnut colour in front. In their shape they somewhat recall those of the beaver. The molar teeth are long, and have the same remarkable alternate triangles marked by zigzag folds of enamel. These prismatic spaces (as they are called), beginning with the first molar on each side of the upper jaw, are respectively five in the first tooth, four in the second, and four or five in the third. In the lower jaw the first molar has seven, the second five, and and third three spaces.[1] The fine glossy hair is a rich yellow or reddish-brown, mixed with a good deal of gray, and even a bluish tinge owing to the gloss. The yellow or red is intensified on the cheeks, on the fore limbs, and on the belly ; but varieties of the water vole are often almost black, or a dark gray. The black variety is generally met with in Scotland and in the east of England. The soles of the feet are flesh-colour, and the claws purple or reddish. The number of teats in the female is five pairs. This vole is not so prolific in the number of litters as in the smaller species. In all probability many individuals only have one brood in the course of the year—in the late spring or early summer. Others may produce a second brood in October. There are from five to six young in a litter, and these are born

[1] As against (in the upper jaw) five, five, and six prismatic spaces in the upper molar teeth, and nine, five, and three in the lower molar teeth in the field vole, showing that smaller *Microtus* in this respect to be more specialised.

in a nest made at the end of a long burrow. The entrance to this burrow, or one of the entrances, may be in the bank of a stream, under the surface of the water. The burrow will be carried in an upward direction, so that the nest may be above flood level. The nest is lined with dry grass or dead leaves. In this resort the water vole will store up food for the winter. It is said that the female water vole, when afraid that her nest has been disturbed, will take up her young in her mouth and carry them away to a place of safety. Burrows and nests are also made by this animal in fields at no great distance from the water, or in sand hills.

Naturally, from its habits, it is never found far away from water, and it has become very aquatic, swimming and diving with ease, and able to remain for several minutes beneath the surface. Mr. Trevor-Battye states that when swimming (unless exceptionally agitated or hurried) it presses the small fore paws against the sides of the body as a seal might do, and uses its long hind feet exclusively for propelling itself through the water, the long tail acting as a rudder. Even unobservant persons should experience no difficulty in distinguishing the water vole from the odious brown rat which has taken to a water life (and whose misdeeds are sometimes attributed to the innocent water vole) by its large, blunt head, short neck, and stout body, which are markedly different from the long, sharp snout and slimmer proportions of the brown or black rats. In many canals and streams in the more inhabited districts, however, there are so many real "water" rats that the water vole has been driven away. As this brown rat that has taken to the waterside is very carnivorous and devours young ducklings, moor-hens, and fish, it has been thought by less careful writers in times past that the water vole was equally omnivorous. As a matter of fact, it appears to be a purely vegetable feeder, and eats the pith of flags, rushes, and other water plants, the buds and seeds and leaves of water-lilies, duckweed (of which it is extremely fond), the bark of willows, roots of many kinds, and, of course, such additional vegetable food as may be afforded by cultivated plants in the

vicinity of streams. It does relatively little damage, however, except to osier plantations, or by pushing its burrows through dams and canal banks. As it is a relatively large and handsome creature, and an almost necessary adjunct to the exquisite stream landscapes still existing in England, it should be placed under protection, and allowed to increase and multiply within due bounds.

As regards its distribution, it is unknown in Ireland, but almost universally distributed throughout England, Wales, and Scotland as far north as Caithness. It has not, however, been found in Argyleshire or in the large islands off the west coast of Scotland. It is found fossil in various parts of Southern England, dating back to, at any rate, the middle of the Pleistocene period, if not earlier. Outside Great Britain the water vole is distributed right across Central Europe and Asia to China.

Evotomys glareolus. The Bank Vole[1]

This animal is perhaps a little smaller than the field vole, measurements of average specimens from the tip of the nose to the root of the tail not exceeding $3\frac{3}{4}$ in., while the tail measures $1\frac{1}{2}$ in., and is consequently a little longer proportionately than the tail of the field vole. Of late years it has been placed in a separate genus, *Evotomys*, owing to the marked difference in the molar teeth from those of the genus *Microtus*. It is perhaps a more generalised Rodent, as the molar teeth develop roots in the adult, while the prismatic spaces in between the zigzags of enamel are fewer in number. The head is shorter and rounder, the nose a little more arched, and the eye larger. The ears are slightly more erect, and perhaps a trifle larger than in the field vole. As regards coloration, the feet are whitish, and there is a white line on the under side of the jaws. The sides of the muzzle, the chest, belly, and the insides of the limbs are pale gray, as is also the under side of the tail. The upper parts of the body are yellowish-red or chestnut, and the upper part of the tail tends to become blackish-brown. The breeding habits resemble those of

[1] Sometimes called the wood vole, or red vole.

the field vole, and in well-wooded districts, such as the New Forest, the animal may be subject to those periodical increases described in connection with the field vole, though, as it is more dependent upon woods and plantations for its existence, it has not the same scope for development. It does not burrow so much as the field vole, but prefers to make its home in the interstices of banks, especially choosing crevices behind the roots of trees. Its food is similar to that of the field vole, though comprising perhaps more insects, and possibly birds' eggs. It does an even greater amount of damage to the bark and buds of trees. It also roots up and devours bulbs, and is a terrible pest in a garden.

The distribution of this animal extends over England and the southern half of Scotland. It is not found in Ireland. In England its fossil remains are met with as far back as the Pleistocene period. It is a rarer animal than the field vole, no doubt because it affects forested country. Outside England it ranges across Central Europe through Asia and China, with a near ally (perhaps only a local variety) in the Arctic regions, and another in North America.

Myodes lemmus. The Lemming

The Lemmings are distinct from the voles by being more clumsily and stoutly built, with a short head and a large arched nose, very small ears, and a short, stumpy tail. The soles of the feet, moreover, which are naked and padded in the voles, are furred in the lemmings, and possess much longer claws. There are also differences in the skull, due to its greater breadth and massiveness. The incisor teeth are without grooves. The molar teeth also, though vole-like, are even more deeply incised by the triangular zigzags.

The common or Norwegian lemming is about 5 in. in length. Each of the four feet has five toes, armed with strong claws in the front paws. The soft fur is yellowish-brown marked with blackish-brown streaks extending from the nose to the back of the head, and from the brows to the ears. The common

lemming is at the present day an inhabitant of Scandinavia, but was once widely distributed over Europe, and only recently became extinct in Northern Portugal.[1] Its remains are found fairly abundantly in Southern and Eastern England, and in North-east Ireland, dating from the Pleistocene period.

Cuniculus torquatus. The Banded Lemming

The Banded Lemming differs from the True Lemmings of the genus *Myodes* in coloration, in the almost complete absence of an outer ear, the shorter, thicker feet, of which the first toe in the fore feet (the thumb) is reduced to a mere claw, and also by the exaggerated length of the claws on the third and fourth toes in the fore feet. The molar teeth are less specialised, and more like those of the voles. But, except for this, the genus *Cuniculus* is a much more specialised form than the true lemming. Its colour is a curious mingling of chestnut, orange, black, pale gray, bluish-gray, and umber, the fur on the back having an undulating gloss which looks like watered silk. The belly and throat are bluish-gray, and there is a black line from the nose along the back to the short tail, broken completely or partially by a gray collar round the neck. The present range of the banded lemming is circumpolar. It is found in the extreme north of Russia and Novaia Zemlia (but not in Spitzbergen), in Northern Siberia and the extreme north of America and Greenland; but during the Pleistocene period it inhabited Southern and Eastern England, and existed to an even later date in Germany, Belgium, and France.

[1] A closely allied species inhabits Siberia, Alaska, and Northern Canada.

CHAPTER XII

ORDER: *UNGULATA.* HOOFED MAMMALS: ELEPHANTS, RHINOCEROSES, AND HORSES

THE absence of primitive types of Ungulates from the deposits of the early Eocene in Europe, perhaps also in Asia, causes Professor H. F. Osborn[1] to argue that the Ungulates originated in North America together with the ancestors of the Edentates, and possibly those of the Rodents and Primates. But a good many primitive types of Ungulates reached the British Islands, perhaps as early as the time in which these islands were rather a dependency of North America than a peninsula of Europe; and during the succeeding periods, commencing from the connection of the British plateau with the European Continent down to the invasion of these countries by devastating man, hoofed animals of large size and strange developments flourished in England and Scotland, and to a lesser degree in Ireland.

The earliest forms of Ungulates probably reached these islands directly from America in the opening part of the Tertiary Epoch. Later on the route was reversed: they travelled hither from Asia and Africa through France and Belgium. Towards the end of the Pleistocene period, the revived connection with Arctic America by way of Iceland, Greenland, and the ice floes of the Glacial ages, may have brought us one or two circumpolar types; but even these, too, more probably came here from Siberia through Central Europe.

[1] President of the New York Academy of Sciences; pupil, and in many respects successor, of the great American palæontologist, Cope.

Modern zoologists divide the great Ungulate group—the Hoofed Mammals—into the following principal divisions or sub-orders, most of which are extinct. There is a hypothetical parent-group called by von Zittel "*Protungulata*," which, seemingly, gave rise to three divergent sub-orders—the *Condylarthra*, the hypothetical *Platyarthra*, and the *Prohyracoidea*, or ancestors of that diminished group of which the little hyrax of Africa is the only living representative. From the *Condylarthra* sprang the Odd-toed and the Even-toed Ungulates (*Perissodactyla* and *Artiodactyla*), which are the dominant Ungulates of to-day. It is possible, also, that from the *Condylarthra* arose a very aberrant group of Ungulates, in which the hoofs (as in the camel and in other early types of Artiodactyle) had retained, or reverted to, a claw-like growth. These are known as the *Ancylopoda*. From the *Platyarthra* arose the *Amblypoda*[1] and the *Proboscidea* (elephants). Lastly, from the *Prohyracoidea* (a divergent group of early Ungulates no doubt akin in origin to the stocks which gave rise to the Primates and the Rodents) were developed the extinct sub-orders of the *Toxodontia* and *Typotheria* (South America), together with the *Hyracoidea*, which at the present day are represented by the hyraxes of Africa and Syria.[2] The only sub-orders of Ungulates which are now or have been in the not-far-distant past represented in the British Islands are the elephants (*Proboscidea*), the Odd-toed (*Perissodactyla*) and the Even-toed (*Artiodactyla*) Ungulates.

[1] A remarkable group of early Ungulates, offering faint resemblances in their structure, but not in their dentition, to the elephants. They are celebrated, amongst other points, for their extravagant development of the canine teeth into long tusks, and for the huge, bony, horn-bearing processes of their skulls, which were evolved in the American forms. A relatively early type of Amblypod was *Coryphodon*, with great canine tusks, and, in the lower jaw, large proclivous incisors. A *Coryphodon* once dwelt in Camberwell, among other places, its remains having been found there at the bottom of a well.

[2] Extinct members of the Hyrax group are found in Europe and Asia Minor.

SUB-ORDER: *PROBOSCIDEA.* ELEPHANTS

It is now thought that the Elephants originated in North Africa, their original centre of evolution perhaps including the eastern basin of the Mediterranean. Dr. C. W. Andrews, travelling through the Fayūm district of Lower Egypt (where the Nile once formed a considerable lake in the Libyan Desert), came across early Tertiary deposits, one of which, of the Upper Eocene, contained remarkable Proboscidean remains attributed to a creature which has been named *Mœritherium lyonsi.* This creature, which offers slight resemblances in its teeth (allowing for the dwindling canines) to *Coryphodon*, had three incisor teeth and a small canine on each side of the upper jaw, and two proclivous[1] incisors; possibly, also, a minute canine on each side of the lower jaw. In the upper and lower jaws there were three premolars and three molar teeth, and in the succession of the last-named (by teeth growing up from the inside of the jaw bone and successively displacing the worn-out molars) there is a hint at one of the most peculiar features characterising the elephants of to-day. Apparently in North Africa, or the eastern basin of the Mediterranean, the mastodon, dinotherium, and no doubt other unknown forms of Proboscideans, developed from this primitive type of *Mœritherium.* From this focus between Egypt and Syria the mastodon (of which a very early type was found in the same Fayūm deposits) travelled into Asia (where from the Stegodonts the True Elephants were developed), and from Asia into America (North and South) on the one hand, and Europe on the other. The mastodon, the earlier types of which had tusks in the lower as well as in the upper jaw, thus became the most widely spread form of elephant, having apparently reached to every country in the world, with the exception of Antarctica and Australia. The remains of two species (*Mastodon arvernensis* and *Mastodon borsoni*) have been found in East Anglia (Suffolk Crag), but as these were probably not contemporaneous with

[1] Perhaps it is necessary to explain that this word means inclined forward in a horizontal direction.

man in these islands the mastodon need not be described here in detail.

FAMILY: *ELEPHANTIDÆ.* THE ELEPHANTS

The family of the Elephants, besides the genera *Mastodon* and *Stegodon*, includes that of the elephants proper, *Elephas*, a genus which almost certainly originated from a Stegodont form of mastodon in Eastern Asia, and spread thence (firstly in the form represented to-day by the African elephant) into Western Asia, Africa, and Europe. Thus, though Africa was the source of the Elephant sub-order, it was probably not the centre of development from which the True Elephant genus originated.

The elephants are not only remarkable by their great bulk (though some of their extinct forms in the Mediterranean basin and in Europe degenerated into pygmy types not larger than sheep or Shetland ponies), but also for the prolongation of the nose into a long, prehensile trunk. It is thought by some zoologists that the original Proboscidean had rather a long, tapering skull, the head ending, no doubt, in a prehensile snout such as has been developed in the pigs, in the insectivores, in the tapir, and in some other mammals. Owing to the disuse of the front teeth, with the exception of the long central pair of incisors, the bones of the skull gradually sank backwards, leaving the premaxillary region (namely, the front portion of the head) unsupported. Their theory, therefore, is that the trunk of the modern elephant represents not only a much-elongated nose, but the fleshy portion of the original upper jaw and ribbed palate.

The elephants have retained the five toes on hind and fore feet. The structure of their limbs is unique, the skeleton of the limb being almost perpendicular, almost vertical from the top of the scapula or of the pelvis to the wrist or ankle-joint—that is to say, there is very little bend when the animal stands erect, either at the knees or at the elbow. The elephants are without collar bones. The nasal opening in the skull, also, is situated very high up, somewhat as in the whales (this, however, is a feature which is met with not only in the whales, but in at least

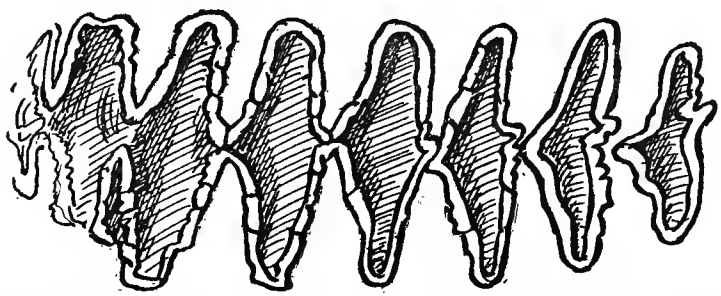
one other family of Ungulates, the *Litopterna*). It is, however, in their teeth that elephants offer the most striking and peculiar characteristics. There are no canines and no permanent premolars.[1] The deciduous premolars (which in children of the human species are lost at seven or eight years of age) last on into the maturity of the animal, and they are replaced by the true molars from the end—that is to say, a true molar forms in the bone of the elephant's jaws near the angle, and as the molar pushes itself up into the gum it squeezes out the first of the deciduous premolars in the anterior portion of the jaw. This process is repeated by the formation and upward growth of two other permanent molars, so that at last in extreme old age all the three deciduous premolars have been pushed out of the skull, and the elephant is grinding his food on the three permanent molars. These are so large that the jaws cannot accommodate more than two, and perhaps a portion of a third, at one time. These molars are characterised by numerous ridges which are gradually worn down in the process of mastication, while the intervals are filled up with a hard cement which forms between the arches of enamel-covered dentine. In the African elephants these arches in the molar are arranged in a continuous diamond pattern; in the Indian elephant they form separate lozenges (*vide* illustrations opposite).

But the teeth of the elephant which are most interesting to the scientific observer are the tusks. These are incisor, or front, teeth, and, judging from what we see in the *Mæritherium*, they represent the two middle incisors, not the first or the third in the series. These incisors in existing elephants are only developed, one on each side, in the upper jaw. In some of the earlier mastodons, however, there were incisors (tusks), fairly long or quite rudimentary, in the lower jaw as well; while in the extinct *Dinotherium* the incisors of the upper jaw had apparently dwindled away completely, while the pair in the lower jaw had developed into strong tusks. In the mastodons

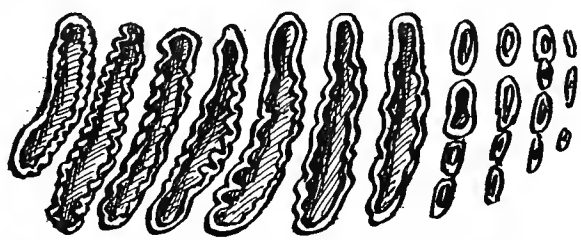
[1] Permanent premolars occasionally make their appearance in a very reduced form, and without functional capacity in extinct species of elephant.

these huge incisors have a band of enamel over the lower portions; but this enamel has almost entirely disappeared in the tusks of modern elephants, being reduced to a small patch at the top, which is soon worn away in the young animal. These incisor teeth begin with a pair of "milk" tusks, which fall out when the young elephant is a few years old, and are replaced by permanent teeth in the ordinary way.

Modern elephants are to a great extent devoid of hair in



PATTERN OF ENAMEL AND DENTINE ON SURFACE OF MOLAR OF AFRICAN ELEPHANT.



PATTERN OF ENAMEL AND DENTINE ON SURFACE OF MOLAR OF INDIAN ELEPHANT.

the adult, except for the fringe of thick bristles at the end of the tail; but the present writer and others have been able to testify that the newly-born African and Indian elephants are fairly well covered with hair—are quite hairy animals, in fact. In the African elephant this early hair is black. In extinct elephants, such as the mammoth, which grew accustomed to live in cold climates, the hair developed to an extravagant extent. Excessive development of any organ or feature often runs parallel with complete disappearance. Thus, in the human being as in

the mammoth, there has been excessive development of hair in various parts: in the human on the top of the head, in the mammoth on the sides of the body. Whenever a beast develops enormous tusks, it is a sure prelude to the complete disappearance in any form of those teeth in the degenerate species.

The African elephant is, in some respects, a little less specialised than the Indian, and the two species (at one time distinguished as different genera) form the types of the two main groups of modern elephants. To the African type belongs *Elephas meridionalis* (perhaps the largest of the True Elephants), a beast which stood 13 ft. high at the shoulder; also *Elephas antiquus*. Both of these were found in England, perhaps contemporaneously with man. Elephants of the African type were also found in India anciently, an interesting fact as illustrating the theory that the true elephants were developed from the mastodons from the Stegodont form in Eastern Asia, whence the ancestors of the modern African elephant travelled through the Mediterranean regions to Africa, while other forms of this "African" type penetrated nearly as far as Great Britain. It is thought, however, that these "African" elephants, together with other creatures now associated with the tropical regions, did not penetrate much farther north than Yorkshire, and did not reach either Scotland or Ireland.

Elephas primigenius. The Mammoth

The Mammoth is a development of the Indian group of elephants, which differs from the African in the more complicated structure of the molars, in the smaller ear, in the shape of the head, and in some other points. The mammoth originated probably in Asia, and its first great area of distribution was Central or North-central Asia, from which direction it spread westward as far as Ireland, and eastward into Northern America.[1]

[1] The reader might be again reminded here that as far as the revelations of palæontology go, the American Continent has had but a sparse share of the great Proboscideans. The mastodon developed something like fourteen

The southern range of the mammoth in Europe appears to have been a line more or less coincident with the 40th parallel of North latitude. (Its remains have not hitherto been found in either Scandinavia or Finland.) It did not, therefore, so far as we know, reach the Mediterranean Basin. It became emphatically the one, perhaps the solitary, attempt of the elephants to adapt themselves to a cold climate, though quite possibly when the mammoth flourished there were relaxations of the Glacial temperature which permitted the growth of more abundant vegetation for the mammoth's sustenance than would now be found in such parts of Siberia as those in which the mammoth's remains are so abundant.

What the mammoth looked like we have been able to ascertain from two very interesting sources of information: firstly, when the Russians began to open up Siberia in the eighteenth and nineteenth centuries, there were discovered carcasses of mammoths frozen or otherwise preserved in the ice and peat of Siberia. Several of these were so well preserved that the flesh was eatable, the hair remained on the body, and the contents of the stomach could be analysed; these contents showing that the mammoth had accustomed itself to a northern vegetation, and lived mainly on the shoots of conifers.

The second source of information is still more remarkable. The Abbé Boucher de Perthes started half accidentally the exploration of the remains of Prehistoric man. This exploration brought to light in the deposits of French caverns Prehistoric implements or ornaments of bone and ivory on which some vanished race—possibly allied to the Eskimo—had graven wonderfully truthful pictures of known beasts, such as the

species within the limits of North America, though probably on closer examination it will be found that some of these are only local varieties. Two of these North American mastodons penetrated into South America, and from them were derived two further species peculiar to the southern half of South America. In the Pliocene period the mammoth penetrated from Asia into North America, extending as far south as Mexico, and developing certain local varieties.

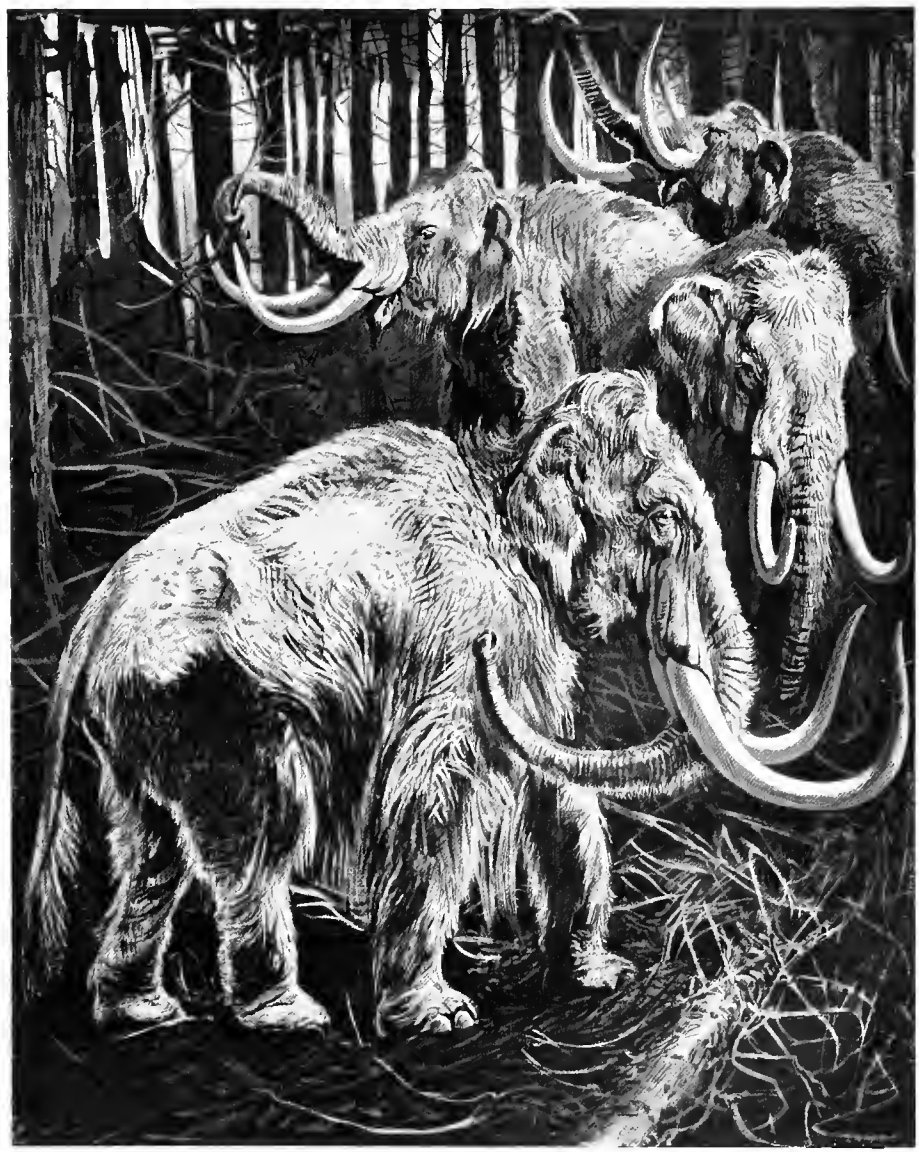
reindeer and the horse, and probably equally truthful representations of the mammoth. The illustration, which is given from the author's drawing, is based partly on one of the more recently discovered and vivid of these representations.[1] In 1895 and in subsequent years MM. Capitane and Breuil discovered on the walls of the Cave of Combarelles, in the wild country of Dordogne, 109 engraved figures which date from a period perhaps 20,000 years ago.

In Ireland the mammoth appears to have lingered almost to the verge of the Historical period, and it still lives in the legends, myths, and fairy stories of the people.[2] Mammoths may still have been living in England 15,000 years ago, but it is probable that they were extinguished in Great Britain at an earlier date than in Ireland, and that they were saved from extinction in the last-named island by its complete insulation.

The molar teeth of the mammoth represent the extreme form of elephantine specialisation in this direction. They are much broader in proportion to the length than are those of any other elephant; and although they offer a close resemblance to the molar teeth of the Indian elephant, they possess more enamel ridges. These are much narrower and much closer together. The skull differed from that of the Indian elephant by having a narrower summit and more prolonged and stronger sheaths necessary to support the roots of the enormous tusks. These tusks in the male often attained a length of 10 ft., measured along the outer groove. They were directed downwards and outwards, then upwards and inwards at the tips, with a tendency to a spiral form. There is, however, great variation in the shape of the mammoth tusks, some of which describe nearly a complete circle, so that there is but little space between the tip of the tusk and the front of the skull, while others are nearly straight. The very much curved tusks which predominated must have become a

[1] Partly also on skeletons of the mammoth and on the structure of the Indian elephant and the growth of hair in its young.

[2] See for this an extremely interesting work, *The Elder Faiths of Ireland*, by A. Wood-Martin.



From a drawing by the Author.

THE MAMMOTH (*Elephas primigenius*).

To face p. 266.

useless burden to the animal, as they were unserviceable for defence or offence, and of no use as diggers for grubbing up trees and roots (the original object of the tusks, and one much evident with the African elephant). It is thought that in the female tusks were present, which were small and straight. The hide of the mammoth was covered almost all over with a dense clothing of woolly under-hair of a reddish-brown colour. In addition there were strange manes of long coarse hair (brown or black), which hung from the sides of the animal and reached almost to the ground. Other fringes and crests of long hair grew along the edge of the ears and at the top of the skull. There was long hair or bristles at the end of the tail as in existing elephants. In height and general bulk the mammoth does not seem to have much exceeded the larger known specimens of its near relation, the existing Indian elephant.[1]

SUB-ORDER: *PERISSODACTYLA.* ODD-TOED UNGULATES

The Odd-toed Ungulates are so named because in their original departure from the five-toed type of early Ungulate (*Condylarthra*) they laid the chief stress of their weight on the third finger or toe of the foot (equivalent to our "second" finger), whereas in the other great upward branch of the *Condylarthra*—the Artiodactyles—the stress was laid on the two middle toes, or fingers (digits three and four, our "second" and "third" fingers). There are other characteristics connected with the formation of the molar teeth which are distinctive of the two great orders of Odd-toed and Even-toed Ungulates, but these, perhaps, are of too recondite a nature to be discussed in this volume. The Odd-toed Ungulates retain that alisphenoid perforation for the passage of the carotid artery, near the base of the skull, which is met with in the Carnivora and several other orders. The Even-toed Ungulates have lost this alisphenoid perforation. There is also a difference in the number of the vertebræ of the back, while, as is known to even unscientific readers, the

[1] Which occasionally reaches to 12 ft. at the shoulder.

construction of the stomach in the Odd-toed Ungulates is much more simple than that of the Even-toed Ungulates, many of which are ruminating mammals. On the other hand, there is a strong outward similarity between some of the members of both groups, though this, no doubt, is due to parallelism. In both Odd-toed and Even-toed Ungulates the teats are usually reduced to four, or even two, and are confined to the regions between the thighs. The pigs (a very primitive form of Artiodactyle) are exceptions to this rule, as in them the mammæ are as many as eight or ten in number, and are placed along the belly from the thighs to the vicinity of the thorax.

The Odd-toed Ungulates at the present day are reduced to three groups only, each of which represents a distinct family—the Tapirs (in South America and Eastern Asia), the Rhinoceroses (in Africa and Asia), and the Horses, which in a really wild state are now only found in the Old World, though originally they were equally abundant in North and South America.

FAMILY: *RHINOCEROTIDÆ.* RHINOCEROSES

An early form of tapir (*Tapirus priscus*), scarcely distinguishable from the existing tapir of South-east Asia, lived in England as late as the end of the Pliocene Epoch. Its remains have been discovered in East Anglia, which exhibits so strong a connection with France and Germany in its ancient fauna, as almost to lead us to suppose that during a great part of the Pliocene it was connected with the European Continent, and separated from a good deal of the rest of England by a strait of the North Sea, which flowed south from what is now the Wash. But as it is very doubtful whether man had already entered Britain whilst this tapir survived, I shall not attempt to describe it as a recent British mammal. I therefore proceed to the consideration of the Rhinoceros family, which was strongly represented in England during the Pleistocene, and almost remained here down to the invasion of these lands by that superior type of humanity which is associated with "Neolithic," or improved stone implements.

The rhinoceroses originated at the beginning of the Miocene period in North America, but all their more wonderful developments of bulk and horns, and their correlative loss of teeth, have taken place in Europe and Asia. The rhinoceroses grew gradually from out of a primitive type of Perissodactyle, not far removed from the ancestral tapir, which, of course, was also the stock from which tapirs and horses and other groups of Perissodactyles arose. The original rhinoceros had four toes on each foot, and a full set of teeth, including the normal number of incisors, canines, premolars, and molars.

It is probable that the early rhinoceroses in America were hornless, though in that country had arisen even earlier a marvellous group, distantly allied to the rhinoceroses in origin, called the Titanotheres, nearly of the size of elephants, and provided with one or more pairs of "horns," represented in their skulls by larger or smaller projections of bone. The rhinoceroses have never grown "horns" in the direct sense of the word; that is to say, so far as the skull is concerned, there is at most a great or small boss of bony matter, which acts as a support to a shorter or longer projection of matted hair. The "horns" of the rhinoceros are simply coalesced hair. They are not bone, like the horns of giraffes or deer, nor are they hollow caps of true horn (a substance like the nail or hoof, and distantly allied to hair), which cap the bony projections in the skull of oxen and antelopes. Increase of specialisation in the rhinoceroses caused them, no doubt, to rely more and more on the mobile upper lip for the collection of their food, and less on the incisor teeth for this purpose; while the development of "horns," or sharp projections of matted hair, replaced as weapons of offence and defence the canine teeth, or tusks, which are so prominent in the early rhinoceros. Consequently in the more advanced types of rhinoceros, living and extinct, there are absolutely no teeth at all in the fore part of the upper jaws, and indeed the fore part of the jaws has ceased to exist. The teeth in these extreme types are merely reduced to molars and premolars. This group is well represented at the present day by the African rhinoceroses, of

which there are two species, the "white," or square-lipped, and the black, or pointed-lipped. Neither of these rhinoceroses has any incisor or canine teeth, at any rate functional, though in the jaws of the immature young traces of incisors sometimes appear. This type of rhinoceros has recently been erected into a special genus, *Diceros*, because of its marked differences from the Asiatic rhinoceroses.

The existing Asiatic rhinoceroses also fall into two groups, possibly of generic value. The first is the original rhinoceros, which was first described by scientific men—*Rhinoceros indicus*, the one-horned, absolutely hairless rhinoceros of India, in which the hide thickens into great ridges and folds, curiously simulating armour. This curious feature of the excessive thickening and folding of the skin is common to the one-horned and two-horned Asiatic rhinoceroses, as is also the retention of functional incisor teeth. But the rhinoceroses of Eastern India and Malaysia differ from *Rhinoceros indicus*, and from its Javanese ally, in having two horns, and in some anatomical features they possess a certain affinity to the African types, though on the whole they are most nearly related to *Rhinoceros indicus* on account of retaining the incisor teeth. The two-horned Asiatic rhinoceroses are sometimes classed as a separate genus.

At the close of the Pliocene Epoch there were probably two, if not more, rhinoceroses in England, the remains of which are found in the red crag formations of East Anglia. One of these, *Aceratherium incisivum*, was hornless, while the other, which carried two horns (*Rhinoceros dihoplus*), is somewhat allied to the living two-horned Sumatran rhinoceros ; but it is doubtful whether either of these existed in Britain coincidently with man. At the end of the Pliocene and during the earlier part of the Pleistocene Epochs there appeared in England (coming from France) the Leptorhine and the big-nosed rhinoceroses (*Cœlodonta*, or *Diceros*, *etruscus* or *leptorhinus*, and *Diceros megarhinus*). Both of these, especially the last-named, were closely related to the pointed-lipped African rhinoceros of to-day (*Diceros bicornis*) ; indeed, it is possible that the

Megarhine rhinoceros above mentioned was identical with this common African species. Lastly, there co-existed with man in Britain, down to quite a late period, the woolly rhinoceros (*Diceros antiquitatis*).[1] This creature appears to have been very closely allied, structurally, to the large "white," or Burchell's, rhinoceros, which still lingers in East and South-Central Africa (*Diceros simus*, the Square-lipped). The woolly rhinoceros evidently persisted in Europe and Siberia, if not in England, down to the verge of the Historical period.[2] Its body was covered with woolly hair. It is supposed to have carried a tremendous front horn, longer even than the longest known horn of the white rhinoceros, that is to say, perhaps as much as 5 ft. or more in length. The length and weight of this horn have been inferred from the special bony wall which has been developed in the skull between the nasal bones. The Tichorhine rhinoceros had, of course, two horns, as in other members of the genus *Diceros*. In bulk it was, perhaps, larger than the largest known specimens of the white rhinoceros when fully mature, though this idea is only derived inferentially from the proportionate size of some of the bones. In the entire specimens of the Tichorhine rhinoceros which have actually been preserved for our inspection in the frozen soil, the size was not larger than that of the existing African rhinoceroses. The woolly rhinoceros had a smooth hide, like that of the African forms, without the folds in the skin characterising those of Asia. The fur grew

[1] Sometimes called the Tichorhine rhinoceros, and, of course, given the generic title of *Rhinoceros* by all older writers.

[2] Some of the legends of monsters and dragons that were killed by popular heroes in Germany, Hungary, and Poland seem even to have been based on the destruction of lingering specimens of the woolly rhinoceros. It is stated, though I cannot find the requisite authority, that a traveller in Germany, asking to see the remains of a monster kept in a castle as a relic of some past deed of prowess, was shown the skull of a rhinoceros; and at Klagenfurt, the head of a supposed dragon preserved in the Town Hall, and used as the model for a monster killed by a knight, and represented in the statuary of a fountain, is stated by Herr Unger, of Vienna, to be the skull of a woolly rhinoceros.

thickly on the skin, and appears to have formed great bunches of hair round the feet (somewhat as we see in the artificially-developed cart-horse). As in the case of the mammoth, the undergrowth of woolly hair was supplemented by fringes of longer and coarser hairs on certain parts of the body, such as along the flanks and throat and the edges of the ears. The hair of one of the specimens found in Siberia is said to have been ash-coloured.

In view of the fact that human remains and implements have unquestionably been found associated with the remains of the woolly rhinoceros in Belgium, England, France, etc., and that this family certainly co-existed in Europe with man, it is very strange that amongst all the drawings or sculpturings of Prehistoric man discovered (mainly in France), apparently there is no representation amongst them of so striking and terrible a beast as must have been this immense, two-horned, hairy rhinoceros.

FAMILY: *EQUIDÆ*. THE HORSES

In this family the five toes of the primitive Ungulate have gradually dwindled to only one functional toe, with, in the earlier forms, two small useless toes in addition, one on either side of the big third toe or finger. These (the second and fourth digits of the mammalian hand or foot) are only represented by the splint bones in the horses of to-day. Even the modern horse, however, occasionally "reverts" to a former condition, and foals are sometimes born and grow up with the traces of as many as four toes in all, some even with one or other of the splint bones enlarged into a complete toe, with a hoof at the end. Another condition of specialisation in the True Horses lies in the molar teeth.

The horses have six incisors above and below, and canines in both jaws, though in the modern species canines are sometimes wanting in the female. The incisors of horses have a peculiarity not found in the teeth of any other mammal, in that a curious deep pit, or groove, is formed in the crown of the tooth,

penetrating it nearly to the root. There are four pairs of premolars in the upper, and three in the lower jaw, while on each side of both jaws there are three molars. The molar teeth of the modern horses are extremely long-crowned, or hypsodont. The triple fangs of the root have, in course of time, become quite inconspicuous, and the tuberculated, crater-like crown of the old type (such, for instance, as is seen in the molar teeth of a man) is lengthened and lengthened until it is nearly three times as long as the roots, while its surface is folded into intricate zigzag ridges of dentine bordered with enamel. The development of the horse's teeth is illustrated in so many modern works of zoology, coincidently with the gradual diminution of the toes and of the secondary bones in the arm and leg, that it is not necessary to go further into the question here.

A three-toed horse (*Hipparion*) once inhabited England, but became extinct before the arrival of man. When man came to these islands—these peninsulas of Europe, as they then were—he possibly found still lingering a somewhat primitive type of horse, *Equus stenonis*, the molar teeth of which offer some approximation to those of the Hipparion, or three-toed horse. But True Horses, more or less similar to those still found existing in Tibet and perhaps in Central Asia, made their appearance in Britain in the middle of the Pleistocene Epoch, and had soon overrun England, Wales, Scotland, and Ireland.

Equus caballus. The True Horse

The genus *Equus*, which includes *Equus stenonis* above mentioned, seems to have originated in India or some contiguous parts of Asia from a form like *Protohippus*.[1] This early type spread westward as far as Britain, and into North America. Other one-toed horses had probably been developed in North America, previously, from *Protohippus*, and had spread right down into the extreme end of South America, where they only became

[1] The *Protohippus* with two small lateral toes was, as far as is known, North American, but an allied form more equine than *Hipparion* may well have inhabited Eastern Asia.

extinct quite recently (*Onohippidium*, for example). *Equus caballus*, practically identical with *Equus przevalskii*, also seems to have been evolved in Asia ; while forms closely allied to this species migrated to America, and filled the whole of America during the Pleistocene Epoch with horses belonging to the genus *Equus*. *Equus caballus* itself, however, does not seem to have entered North America, but to have confined its range to the whole of Europe and Temperate Asia. The only living wild horse—*Equus przevalskii*—is scarcely separable specifically from *Equus caballus*, and photographs of it may well stand for representations of the kind of horse familiar to our far-distant ancestors as the wild horse of Britain.[1] But there also developed from the original horse stock in Asia, other types belonging to the ass and zebra group which are scarcely distinguishable from Caballine horses in their bones or teeth, though they may be very different in outward aspect, in the markings, the growth of the mane, of the tail, and of certain callosities on the inner side of the hind limbs.

There is almost every graduation in form between the horse-like wild ass, *Equus hemionus* (the Kiang) and the magnificent, liberally striped Grévy's zebra of Eastern Africa. The asses and zebras mainly differ from the True Horse (1) in their having a stiff, hog-like mane ; (2) in the absence of a fully plumed tail (that is to say, they have a tail in which the long hairs grow merely in a tuft at the end, and do not start growing from the base of the tail) ; and (3) in the fact that all the zebras and one or two of the asses are striped to a greater or less degree. It has been said that a form of ass, probably identical with that source of the domestic donkey, the wild ass of North-east Africa (*Equus tæniopus*), has been found fossil in England in the Pleistocene formations, but this statement is of doubtful value, and von Zittel equally doubts the existence of this animal (in a wild state) in Central Europe. There is so little to distinguish the African wild ass from the horse in its teeth, or even in the

[1] The adult males of this Prjevalski's horse in Woburn Park are singularly like underbred cart-horses.

Photo by W. P. Dando, F.Z.S.

PRJEVALSKI'S HORSE.

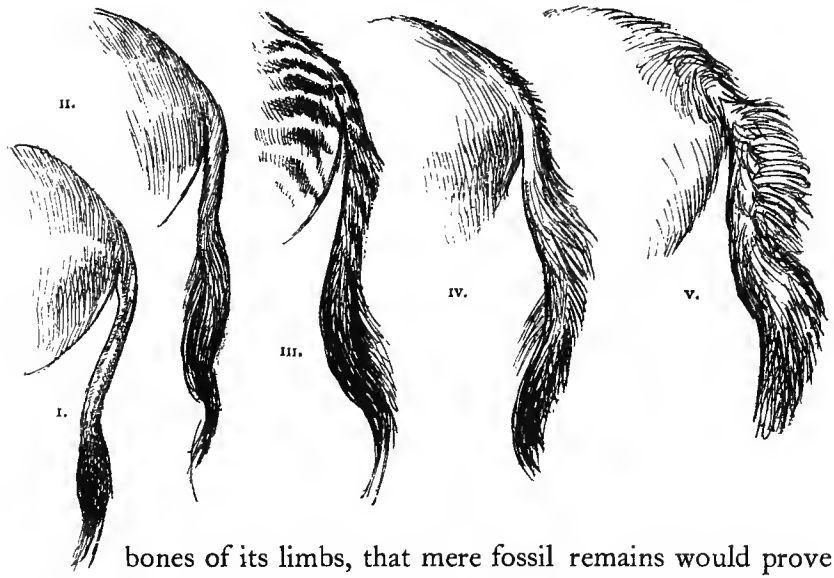
Notice faint stripes on fore leg.

Photo by W. P. Dando, F.Z.S.

PRJEVALSKI'S HORSE (*Equus przevalskii*).

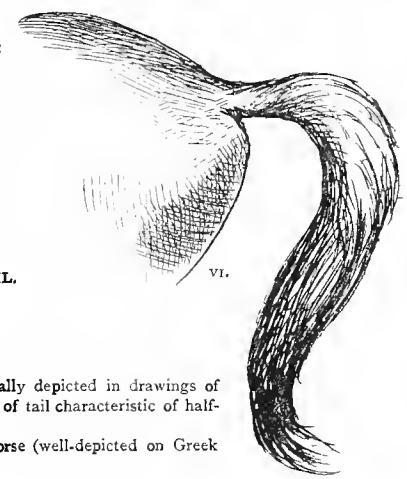
This is almost identical with the original wild horse of Britain and Central Europe, from which the northern breeds of domestic horse are descended.

To face p. 274.



bones of its limbs, that mere fossil remains would prove nothing conclusively. From other evidence we are entitled to presume that no species of wild ass penetrated as far north and west as the British Islands.

The wild horse which the earliest men may have encountered in Britain—*Equus stenonis*—was probably striped and dappled with a lighter colour on a reddish ground. (A piece of skin preserved in a cave in Patagonia, which there is reason to believe belonged to the extinct and allied *Onohippidium*, was foxy-red, with spots and dapplings of a reddish-yellow.) The True Horse, *Equus caballus*, which succeeded it, in its



THE EVOLUTION OF THE HORSE'S TAIL.

I. African wild ass (common donkey).
II. Asiatic wild ass (onager).
III. Zebra.
IV. Kiang (*Equus hemionus*).
V. Prjevalski's wild horse (and the type of tail usually depicted in drawings of horses by Prehistoric man in France. The type of tail characteristic of half-wild breeds of Northern Europe).
VI. The tail of the Arab or South Mediterranean horse (well-depicted on Greek vases from Cyprus as early as 1000 B.C.).

early forms probably bore dark stripes on the limbs and perhaps on the shoulder, and dapplings on the body. The true Connemara ponies (which there is reason to think are descended directly from the wild horse of Ireland), the modern Norway ponies (also descendants of the Norwegian wild horse), and Prjevalski's wild horse of Tibet in its summer coat (besides also country-bred horses in India) frequently display two, three, or more dark stripes on the fore limb between the wrist and the elbow, and sometimes one dark stripe on the shoulder. They nearly always have a longitudinal dark stripe all along the ridge of the back, such as is seen in the asses. Many horses, feral and domestic, show distinct light dapplings on the flanks and the hind quarters.[1]

The theory of the present writer is that the original markings of the Horse group were not (as imaginative artists are wont to depict in restoring extinct types) zebra-like black stripes on a pale ground, but, like the primeval markings in so many mammals, white or pale spots and stripes on a dark ground. Gradually the light-coloured spaces grew and grew, till they coalesced in the lower parts of the body, making the belly and the limbs uniformly light-coloured. The dark spaces that were left grew darker in the case of the asses and zebras, until they became brown or black stripes and spots. In reality the stripes (on the legs of the wild ass, for example) are merely the remains of the original dark colour of the fur, where nearly all the rest of the body has been swamped in light colour, or where the alternate light and dark markings have fused into a brown or ash-coloured tint.

It is not advantageous, as a rule, to wild animals to be excessively white, so that when these white markings had spread till they enveloped nearly the whole of the coat they tended to become dun or cream-colour. In the horse the white markings

[1] These spots may be often quite clearly distinguished and drawn if the horse is closely clipped. Seen in a favourable light, these dapplings are like loops and spots between darkish spaces answering to the stripes of the zebra.

grew darker, and the chestnut or dun-coloured intervals fused with them. Only on the limbs did the dun-coloured intervals turn to blackish-brown, while the fused white markings darkened to chestnut. In the tapir, which is a distant relation of the horse, and the young of which are profusely spotted and striped with white, we see something like the original coloration of the horse, which is only represented to-day by the stripes of the zebra and the dapplings of horses. The same white spots and stripes were the characteristic of the primitive Artiodactyles, and are exhibited to-day in the coloration of nearly all young pigs, in the permanent markings of the tragulines,[1] in the deer, the giraffe, the okapi, and the tragelaphine antelopes. So that the parent forms of the horse were originally marked with white spots and stripes ; not black, as in the modern zebra.

Equus caballus, or the True Horse, seems early in its development to have exhibited two varieties, or sub-species. One (represented by the modern Arabian horse) was characterised by a small finely shaped head, a long mane, a smooth coat, and a tail which was set on the body in such a way that the base of the tail advanced a few inches in a horizontal direction before making the downward sweep. This tail also was abundantly plumed with hair, commencing at the very root. In this type of horse the profile of the nose is either straight or slightly concave.

The other and more northern type of horse is well represented by the wild or semi-wild tarpan of Central Asia and the Russian Steppes, a form which, though said to be feral—*i.e.*, to have run wild—is as likely as not to be the original wild horse of Europe. This type, with the clumsy head and Roman nose, and (in the original) a hog-like mane and a tail poorly furnished with plume near the base, finds its highest expression in our modern cart-horse. This was the horse that was hunted, eaten, tamed, and ridden by primitive man in Europe and in Britain almost since man appeared in this part of the world.

It would seem as though the earliest domesticated of all animals had been the dog, in the sense that various types of

[1] Primitive pig-like ruminants found in Africa and Asia.

wolf, jackal, and cyon[1] took to prowling about the vicinity of human camps, and gradually attaching themselves to the society and the service of this successful anthropoid ape. But certainly the next beast to be brought under man's influence—perhaps the first which he deliberately domesticated, in Europe at any rate—was the horse. In the earliest Greek art of Cyprus, Greece, and the Greek islands two types of horse are plainly depicted (as may be seen, for instance, in the collections illustrating Greek art in the British Museum). One—familiar to all of us from many a magnificent bas-relief and statue—is the true *Equus caballus* type : the sturdy, hog-maned, arch-nosed horse which has been the principal breed of North Europe. The other (which is shown specially in paintings on vases obtained in Cyprus) is the Arab horse, with its fine head, smooth limbs, long mane, and well-furnished tail. The various blendings or special developments of these two varieties have given us all the breeds of domestic horse which exist at the present day throughout the whole world, for it is needless to remark that when the Caucasian entered America all the indigenous American horses had completely died out, and the wild horses of to-day in America are simply the descendants of *Equus caballus*, introduced in a domestic form by the Spaniards, Portuguese, French, and English.

It is fairly certain that the Shetland pony is descended direct from a dwarfed form of the wild *Equus caballus*, and that the same may be said of many breeds of ponies in the west of Ireland, and less certainly of the ponies of the New Forest. The Romans, of course, introduced their domestic equine breeds into Britain. These, too, were mainly derived from the Northern stock. By various indirect means, however, from the time of the Roman Conquest down to the seventeenth century, tinges of the Oriental stock began to affect the domestic breeds of the British horse, coming to England, no doubt, in the form of barbs[2] ; and these mixed types sprang from the union in the

[1] See p. 128.

[2] Barb, of course, stands for Barbary. The Barbary horse of North Africa is probably the result of an early cross between the Northern and

Mediterranean Basin of the Northern and the Oriental breeds. But early in the eighteenth century, through increased commercial and diplomatic intercourse with Turkey and the Levant, the Arabian stallion was deliberately introduced into these islands to modify the local breeds, which in some types are almost more Oriental than Northern.

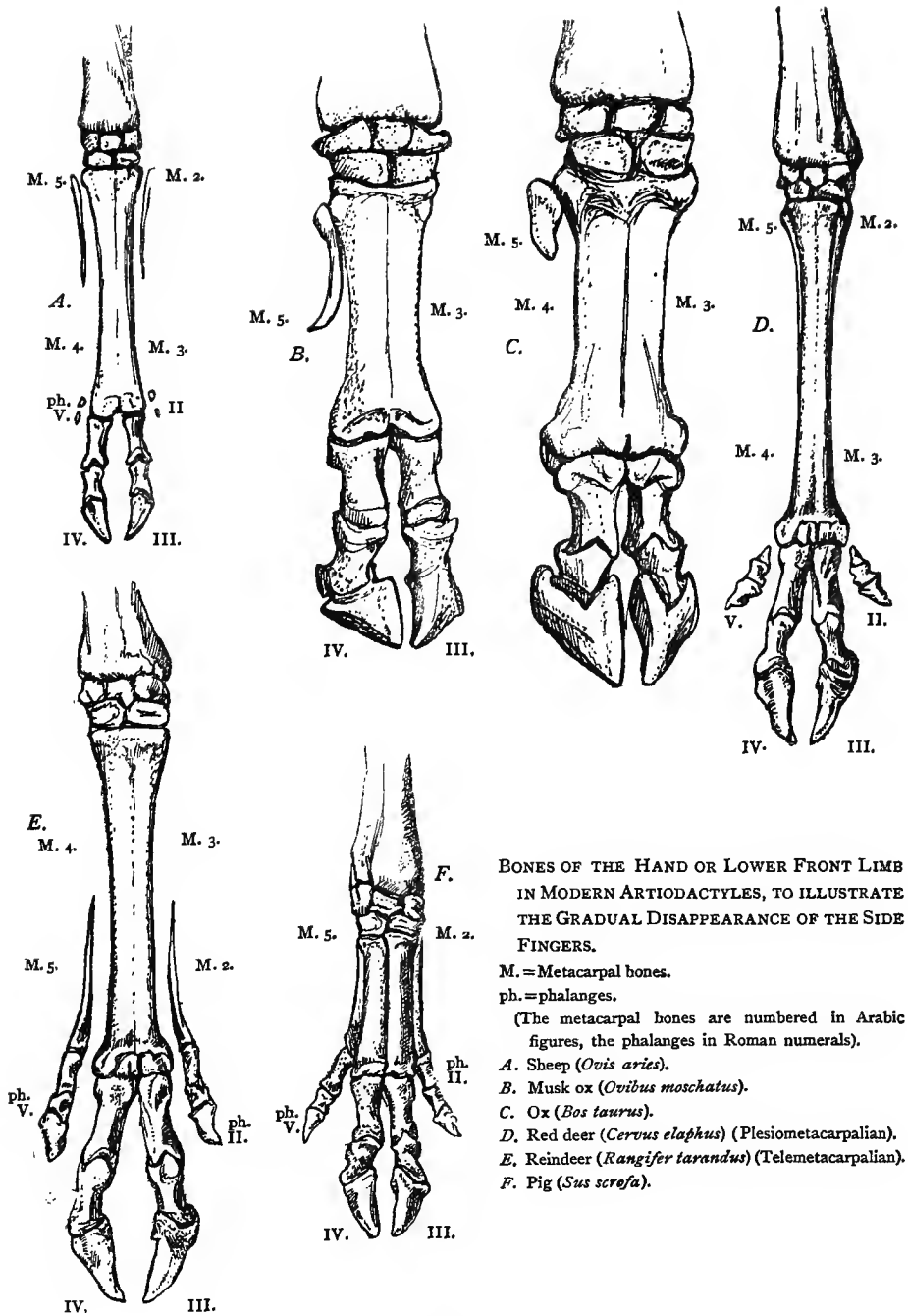
the Oriental types in North Africa. The original stock of the barb may actually be descended from the wild *Equus caballus*, which certainly existed in North Africa, and which need not have been extinguished by the advent of man.

CHAPTER XIII

UNGULATA (continued). ARTIODACTYLA: HIPPOPOTAMUSES, PIGS, AND DEER

SUB-ORDER: *ARTIODACTYLA.* EVEN-TOED UNGULATES

THE leading characteristics of this important modern group of Ungulates have been delineated in the description of the Perissodactyles. Their main feature is, of course, that they rest the stress of their weight on two toes (the third and fourth of the mammalian series, our "second" and "third" fingers) instead of on a single toe. Therefore in the course of their development they tend to become exclusively two-toed, just as the Perissodactyles have advanced towards a one-toed condition. The Artiodactyles arose very early in the development of the Ungulates, from a stock (the *Condylarthra*) which gave rise to the Perissodactyles. The earliest known types of Artiodactyles had five digits on hind and fore limbs. The digit that is equivalent to our big toe very early disappeared in the hind feet of the Artiodactyles. Then the thumb was lost in their hands. In those days, of course, the extremity of the fore limb was much more like a hand than is the case with the attenuated, highly specialised limb of the modern Artiodactyle. In looking at an antelope or a deer, for instance, it is hard for unlearned persons to realise that from the wrist (which is falsely called the knee) down to the tip of the hoof we have merely a modification of the human hand. In hands and feet man is far more archaic than the stag, or the horse. He has not, in fact, advanced in this respect much beyond the reptile. Artiodactyles that have merely



BONES OF THE HAND OR LOWER FRONT LIMB IN MODERN ARTIODACTYLES, TO ILLUSTRATE THE GRADUAL DISAPPEARANCE OF THE SIDE FINGERS.

M. = Metacarpal bones.

ph. = phalanges.

(The metacarpal bones are numbered in Arabic figures, the phalanges in Roman numerals).

A. Sheep (*Ovis aries*).

B. Musk ox (*Ovibus moschatus*).

C. Ox (*Bos taurus*).

D. Red deer (*Cervus elaphus*) (Plesiometacarpalian).

E. Reindeer (*Rangifer tarandus*) (Telemetacarpalian).

F. Pig (*Sus scrofa*).

reached the four-fingered stage are well illustrated at the present day by the hippopotamus, the swine, and those curious little creatures, the tragulines,[1] which represent the parent stock of the modern Ruminants. Outside these groups such creatures as deer, oxen, sheep, antelopes, giraffes (*Pecora*), and camels have entirely, or to a great extent, lost the bones of the outer toes, though in some cases they still retain fragments of these; and, except in the giraffes and a few antelopes and in the camels, the missing toes are still represented by what are called the false hoofs, so that at first sight an ox, a sheep, or a deer appears to be four-toed. Not only in the course of evolution did the higher Artiodactyles reduce their functional toes to a pair, but the first bones of those toes (which are called the metacarpals and metatarsals[2]) gradually fused into a single bone (called the cannon bone), down the middle of which a slight groove indicates in some forms the original duplicate character of the bone.

The Artiodactyles also show considerable modifications in their teeth, as they differentiate from the main stock In the hippopotamus and the pig the teeth are of a more generalised character. There are in most swine, and in the earlier types of hippopotamus, the full number of six incisors above and six below. Canines are likewise present in both jaws, and there are generally four pairs of premolars and three of molars in each jaw. Moreover, in the swine and in the hippopotamus the molar teeth are short in the crowns, and their surface is divided into a number of nipple-like mounds, originally four in number in each tooth. These two groups also, together with many extinct allied families, exhibit no tendency whatever to the growth of bony, horn-bearing projections from the skull.

In the more modern types of Artiodactyles, represented by the camels,[3] tragulines, and horn- or antler-bearing *Pecora*, the incisors in the upper jaw are either reduced to one on either

[1] Pygmy musks, chevrotains.

[2] These metacarpals (for instance) are the five bones bound up in the palms of our hands.

[3] Which, however, are quite an independent development.

side, as in the camels, or disappear absolutely, as is the case with the tragulines and *Pecora*. Canine teeth tend to disappear in the upper jaw, though they are retained by the camels and tragulines, and by some deer. In the lower jaw a marked feature of this section of the Artiodactyles is that the canine tooth grows close up to the lower incisors, and tends to resemble them exactly in appearance. In the lower jaw of an ox, for instance, the unlearned observer would decide that there were no canine teeth at all, but four incisors on each side instead of the normal three. As a matter of fact, the outer tooth in this range is a canine. The molars also develop an ever-increasing length of crown ; many of them are hypsodont, as in the horse. Moreover, all the molar teeth of camels and *Pecora* are what is called "selenodont," that is to say, their enamel ridges assume a crescent shape, so that the grinding surface is a series of half-moon-shaped ridges, instead of a number of blunt hillocks as in the swine.

The Even-toed Ungulates described below are those now existing in the British Islands, or which are known to have inhabited some portion of this area since man came on the scene at the beginning of the Pleistocene period.

FAMILY: *HIPPOPOTAMIDÆ*. HIPPOPOTAMUSES

The Hippopotamuses are for the most part[1] huge animals, leading an amphibious life. The tusks, or canine teeth, are enormously developed, especially in the lower jaw. The incisor teeth are also prolonged into tusks. The extremity of both jaws, especially that of the lower, is remarkably broad, and in the lower jaw the canines and incisors as seen from the front are in the same line, that is to say, the canines are pushed so far forward in their growth that they are in no way behind the incisors, as is the case in a normal mammalian arrangement of the teeth. The feet are four-toed, the two central toes being larger and more important than the second and fifth. The skin is bare of hair, with the

[1] Some of the forms isolated in Cyprus and Malta during the Pleistocene degenerated into pygmy types hardly larger than small pigs.

exception of bristles (often bifid) round the muzzle, and a few at the end of the tail. The mammæ are reduced to one pair.

Hippopotamuses appear to have originated, like so many other remarkable beasts, in India, and they arose, seemingly, from an early Artiodactyle family (allied to the pigs) called the *Anthracotheridæ*, the teeth of which, in some forms, bear a strong resemblance to those of the hippopotamus. The earliest known forms of Asiatic hippopotamus had six incisor teeth in both jaws. This type with the six incisor teeth penetrated westwards as far as North Africa, and possibly the south of Europe. From this type there arose in the later Pliocene a hippopotamus with only four incisor teeth in each jaw. This form was identical with the modern African hippopotamus, and reached England in the Pleistocene Epoch, before the Glacial episodes or during the warmer intervals between the Ice ages. It penetrated at least as far north as Yorkshire (possibly during the summer-time), and was coeval with the earliest types of man in Britain. In fact, there were hippopotamuses in the Thames once, larger than those in the Nile at the present day, but not specifically different. No doubt it frequented all the English and some of the Welsh rivers south of Lancashire and Durham. It may have swum the narrow straits of the Irish sea, and have reached Antrim. On the coast of this county remains of the hippopotamus are said to have been found, but they are of a dubious nature, and until better evidence is forthcoming the hippopotamus cannot be classed as an Irish mammal.

FAMILY: *SUIDÆ*. THE TRUE PIGS

The True Pigs, like the hippopotamus, appear to have been confined at all times to the Old World, and never to have existed in America, where they are only distantly represented by the allied group of the Peccaries, and by certain ancestral forms from which both pigs and peccaries sprang. Pigs made their appearance very early in Europe in the Upper Miocene formations, and it is possible that they originated in Central Europe, though they soon travelled to Asia, and in India received some wonderful

developments, one species of True Swine developing to the size of a rhinoceros.

The True Pigs have usually six incisors in both jaws, though in two African genera the upper incisors tend to disappear, a tendency parallel to what has occurred among the Ruminants. As already mentioned, the pigs have "bunodont" molars with short crowns, that is to say, the surface of the molar tooth is divided into a number of blunt hillocks. The most striking feature of the True Pigs lies in the canine teeth. In the upper jaw, instead of growing vertically downwards, as in almost all other mammals, they curve outwards and upwards, and this tendency is carried to such an extreme in the Oriental genus *Babirusa* that the upper canine teeth turn right round from their sockets, and grow straight upwards through bone and flesh. An archaic feature in the pigs is the number of mammæ (from five to three pairs), and their distribution along the ventral region. To this may be added, perhaps, their tendency towards an omnivorous diet, a characteristic shared by the allied peccaries of America. Although this feature is carried to a much greater extreme in the domestic than in the wild pig, still nearly all forms of pig will eat, in addition to various vegetable substances—roots, fruits, nuts, and herbage—animal matter, as represented by snakes, lizards, young birds and beasts, and carrion. Pigs, also, are unlike other existing Ungulates (except one or two species of deer), in that they produce ordinarily more than two young at a birth. Their digestive organs are relatively simple and primitive.

An early type of pig (*Sus palæochærus*), and a gigantic swine as large as a tapir (*Sus erymanthius*), reached England during the Pliocene Epoch, and *Sus erymanthius* may have lingered on into the Pleistocene and the time of man's coming to this country. But with this doubtful exception man has only known one wild pig in these islands, the wild boar, unless, as some zoologists have thought, another wild species of pig of a more slender type, more like the wild pigs of Eastern Asia, existed in Ireland, and gave rise to the domestic greyhound pig, which is now nearly extinct.

certainly suggests intermixture with the stocks derived from the wild pigs of Eastern Asia, which are almost devoid of hair.

The wild boar probably did not become finally extinct in England till the beginning of the seventeenth century. In 1593 (as Mr. Harting points out in his book, *British Animals Extinct within Historic Times*) Erdwick, in his *Survey of Staffordshire*, mentions wild swine as existing in the celebrated Forest of Chartley, which still harbours the feral cattle. In 1174, if not later, there were wild boars in Epping Forest. Wild boar hunts took place in Scotland in the middle of the sixteenth century, and the boar probably lingered on in the Highlands down to the beginning of the seventeenth century, about which period it became extinct in Ireland. It is stated that the Irish wild boar was a somewhat diminutive animal as compared with its brother of Britain and Continental Europe, no doubt through insulation from Europe and interbreeding of the wild stock. Many of them in Ireland, by enclosure of land, seem to have gradually drifted into the condition of semi-domesticated, and finally domesticated, animals. The half-wild pigs in the New Forest at one time had very much the look of diminutive wild boars, but this seems to have been due to the deliberate reintroduction into that forest of wild boars imported by Charles I. But in England, as in Ireland, the last of the wild boars seem to have been enclosed and domesticated rather than exterminated, and in the allusions to boars by the writers of Shakespeare's time it is difficult to ascertain whether they mean the entirely and naturally wild animal or a half-wild pig. Mr. Harting considers that the last truly wild boar became extinct in England as late as 1683, in Staffordshire, and wild boars were killed in Westmoreland a little earlier. King James I. hunted wild boars in Windsor Park in 1617, in which same year he in his progress through Lancashire feasted on a wild boar pie at a banquet given by Sir Richard Houghton.

Camels, which originated in North America, and spread thence right across Asia into North Africa, and perhaps to Greece and Italy, never reached England with other specimens

of the Mediterranean fauna. The chevrotains, or tragulines (*Tragulidæ*), a most interesting group of primitive Ruminants,[1] extended their range in the Miocene and Pliocene Epochs as far north and west as France, but no traces have been discovered of their existence in England. That great group of monster Ruminants, the giraffes, also left England outside their extremest range, so that the first family of true ruminating, selenodont (and horned) Artiodactyles represented in the British fauna past and present is the deer.

GROUP: *PECORA*. HORNED ARTIODACTYLES

The Horned Artiodactyles (among which a few species have lost or have never developed horns) are usually divided into four families, based on the structure of the excrescences growing on the skull, which are loosely known as "horns," independently of their substance. The most primitive of the four families, perhaps, is that of the giraffes, in which bony projections grow out from various points of the skull, but remain practically separate bones. In the Giraffe genus these are merely covered with skin and hair. In the newly discovered okapi it would seem as though the extreme tip of the short bony projection was bare of skin and hair, and might even be an independent ossicle.[2] In certain more extravagant extinct forms of the Giraffe family, such as the *Sivatherium*, these bony projections grew to a great size, forked and branched; and the larger of the projections were probably covered with some sheath of hardened hair or of horn. In the case of the next family, the Prongbucks, a curious and complicated stage is reached. The male prongbuck grows a permanent pair of bony "horns" from the top of the skull, and then these bony projections are covered and increased by a

[1] The Tragulids—even those existing at the present day—represent very nearly the original stock from which the horned Artiodactyles (*Pecora*) sprang, the base from which the giraffes, the prongbucks, the deer, and the Oxen-Antelope-Sheep group evidently arose.

[2] In which case we have a very interesting suggestion as to the way in which the deer's horns began.

somewhat soft sheath of branching horn. This horny sheath in the prongbuck is shed annually and grows up again. In the third family about to be described (the Deer) there is, first of all, a permanent bony pedicle, or core, developed from the skull. (In the muntjacs, a somewhat primitive and ancient type of deer, these pedicles are several inches long, and often more important in length than the little antler which grows from them.) From the end of this bony projection, or pedicle, the deer start another and independent growth of bone, which in the earliest or least developed types of deer is a mere prong or a simple fork. But in all the more extravagantly developed types this additional detachable growth of bone at the end of the permanent pedicle is often of enormous size and weight. Whilst this bony antler is developing during several months, and until its extreme growth has been reached, it is covered outwardly with blood-vessels, skin, and hair, so that in that condition it resembles the "horns" of the giraffe; but when the growth of the antler is complete, the blood-vessels dry up, nourishment ceases to reach the skin and hair, and thus the "velvet" is soon rubbed off by the stag, leaving the naked and dry bone. This lessening of the nutrition continues long after the velvet has disappeared; and finally, about ten months from the time at which the additional growth of bone has started,[1] the complete antler, as far as its connection with its parent pedicle, is easily detached and falls off.

In the last family of this group, the *Bovidæ*, or Hollow-horned Ruminants (Cattle, Tragelaphs, Capricorns, Sheep, and Antelopes), the original bony projection from the skull is continuous with the skull bones and of a permanent nature, growing sometimes to extraordinary lengths. It is never known to branch, as in the aberrant giraffes. As this bone grows up from the skull it is covered by a sheath of horn (no doubt a modification of an original hairy covering), and this horn cap ends in a sharp point, and often considerably exceeds in length the bony core. It has

[1] This period refers to deer—the vast majority—which only renew their antlers once a year. It is, of course, proportionately shorter where (as in Père David's deer) the antlers are *twice* shed in the twelve months.

been said that certain antelopes can shed this horny covering and renew it, in which case they would offer a distinct approximation to the prongbuck's plan; but this statement lacks confirmation, and in all cases which have come under the writer's observation, where antelopes or oxen have by some accident had a horny sheath torn off the bone core it has not been renewed.

All the *Pecora* have the stomach divided into four chambers, and all of them are True Ruminants.

FAMILY: *CERVIDÆ*. THE DEER

With regard to the peculiarities concerning the growth of the deer's antlers, it only remains to add in a general description of this family that antlers are entirely confined to the male (abnormalities apart), except in the aberrant and remarkable reindeer, in which genus the females also grow antlers.[1] All the deer as yet examined have four mammæ. One genus, *Hydropotes* (a hornless deer), produces from three to six young at a time. Forms of primitive deer allied to *Hydropotes* were inhabitants of part of Britain and the rest of Europe in the Miocene period. The young of nearly all species of deer except the elk, the reindeer, and the sambur are spotted with white, the spots sometimes running into horizontal stripes, and these white markings remain permanently, or occur seasonably, in not a few kinds of deer.

It is probable that the deer, like so many other groups, originated in Asia, where at the present day the most primitive and archaic representatives of this group are still found living. But they made their appearance in Europe at an early period, the very beginning of the Miocene, the first forms, of course, being hornless, and allied to such types as *Hydropotes* of China, and the Muntjac deer of India. The earliest type of antlered deer to

[1] At the same time antlered females, fertile and able to breed, do occur in not infrequent instances, scarcely to be called abnormalities, in other genera, such as the roe and even the red deer. "Abnormality" would rather cover those instances of aged or unsexed females which produce stunted antlers, just as aged female pheasants assume male plumage or aged women grow beards.

reach Britain seems to have been the roe (*Capreolus*), a persistent and an archaic form of Cervine. Then came an elk—larger than any now known—*Alces latifrons*. This early British elk may have been a peculiar development of these islands, as no remains of this very large species have been discovered on the Continent. It was possibly one of the forerunners of the Glacial ages, and an instance of the invasion of Britain from the north, by types of animals coming from Iceland, Greenland, and North America. About the same time appeared a deer with a palmated antler, which has been named after Professor Boyd Dawkins (Dawkins's deer), and which may have been a transitional form leading up from the Fallow group (*Dama*) to the *Cervus megaceros*, or Gigantic deer. *Cervus sedgwicki* is a deer which may be related to the Rucervine group.[1] The antlers of Sedgwick's deer (which was possibly contemporary with early man in the first half of the Pleistocene period) are most extraordinary, being a perfect forest of branching points, as many as thirteen on each antler. It is possible that it may be an extreme development in one direction of Dawkins's deer, though there is also a resemblance to the Elaphine, or red deer, type. A deer of very mysterious affinities, and very imperfectly known, which was found in England, at any rate, during a portion of the Pleistocene period, is Buckland's deer (*Cervus bucklandi*), which was about the size of a reindeer. The imperfect fragments of its horns suggest affinities to the roebuck (this is the most probable theory), or to that considerable group of American deer which have no brow tine to the antlers; for the fork in the horns of Buckland's deer starts several inches above the coronet. *Cervus suttonensis* appears to be related to the spotted axis deer of India. *Cervus browni* and *C. savini* were obviously early forms of fallow deer. *Cervus carnutorum*, together with *C. dawkinsi* (*verticornis*), are supposed to be related to the Gigantic deer, and a large stag, with tremendously heavy, round, thick antlers (*C. strongyloceros*), is probably a gigantic race of Elaphine deer, allied to the red deer, and still more to the modern maral of

[1] Such as Schomburgkh's deer and the other swamp deer of Eastern Asia

Persia. The True Red Deer has always been an indigenous inhabitant of these islands since the Pleistocene period, though it probably came here from two different directions,[1] and exhibited several varieties, large and small. Lastly, there was the reindeer, at one time as abundant in England, Ireland, and Scotland as the red deer.

Capreolus capræa. The Roe Deer

The deer are often divided by zoologists into two groups, both, unfortunately, with very long names. The first group, which is called the *Plesiometacarpalia*, comprises the muntjacs and their allies, and all the True Deer (Elaphine, Damine, Rusine, Rucervine, and Axine) of the Old World. This group, which in some respects is the most specialised, only retains the upper fragments (near the wrist and the heel joints) of metacarpal and metatarsal bones of the second and fifth toes. Only the *upper* fragments of these remain, though the actual toes themselves are still represented by outside hoofs (the " false " hoofs), and these hoofs are supported sometimes by minute fragments of bone, the remains of the lost phalanges. On the other hand, the second group (which includes the reindeer, the elk, the roebuck, the hornless *Hydropotes* of China, and all the American deer) belongs to the division *Telemetacarpalia*, in which that portion of the metacarpal or metatarsal bones of the second and fifth toes ordinarily retained is the *lowest* portion, equivalent to the joints of our fingers. This bony support in the lower portions of the limb to the two side toes gives a rather splay appearance to the feet of the reindeer, elk, and some of the other deer. At the same time, seeing how, in the feet of the reindeer, there are occasionally fragmentary traces of the metacarpal bones above as well as below, and that traces of a similar feature exist in one or more of the muntjacs, and having regard to the ease

[1] Portugal and Belgium. Possibly there came first from Portugal or Northern Spain the earlier, smaller red deer without the "bez" tine, which is still found in North Africa and parts of Spain. From Belgium arrived the large, fully antlered red deer.

with which either condition can arise quite independently when all of them are descended from Miocene forms in which the bones of the side toes were complete, the distinction is not a very strong one for natural classification. (See illustration on p. 28.)

However that may be, the roe deer is one of the few Old World examples of the *Telemetacarpalia* (or deer that only retain the bones of their side toes at the end of the limb). The tail in the roe is so short that there is practically no outward manifestation of it between the thick hair of the buttocks. Although nearly related to archaic extinct deer, and to the very primitive *Hydropotes*, or water deer, of China, all of which possess canine teeth in the upper jaw, the roe has lost this feature. Occasionally minute traces of upper canine teeth are found in the males. The ears are fairly long, narrow, and rather pointed, not round, as in *Hydropotes*. The legs are long, flat, and slender, and the hoofs are small. The whole foot, in fact, is closely compressed and "fine," not at all like the rather spreading, pig-like foot of the Chinese water deer. When the roe walks there is a curious interlocking of the hind limbs, which is often more marked than in other deer. Any one who observes the movements of a sheep or cow will notice that as the animal moves its hind limbs in walking the hock remains pretty much in the same line as the buttocks, whereas in the deer the hock twists inwards so markedly at every step as almost to touch the inner flank of the other leg. This movement is specially marked in the roe deer.

The existing roes are not large animals. The biggest males of the European form which is found in England seldom exceed 26 in. in height at the withers. The head of the roe deer is proportionately small. The profile is straight, or slightly concave. The eyes are large, but they are not placed so wide apart as in the red deer (for example). The muzzle is neat and tapering, but there is a considerable expanse of wet muffle about the nose. The under-fur is woolly, and the hair on the upper surface of the coat is coarse, sometimes flattened, stiff, and not

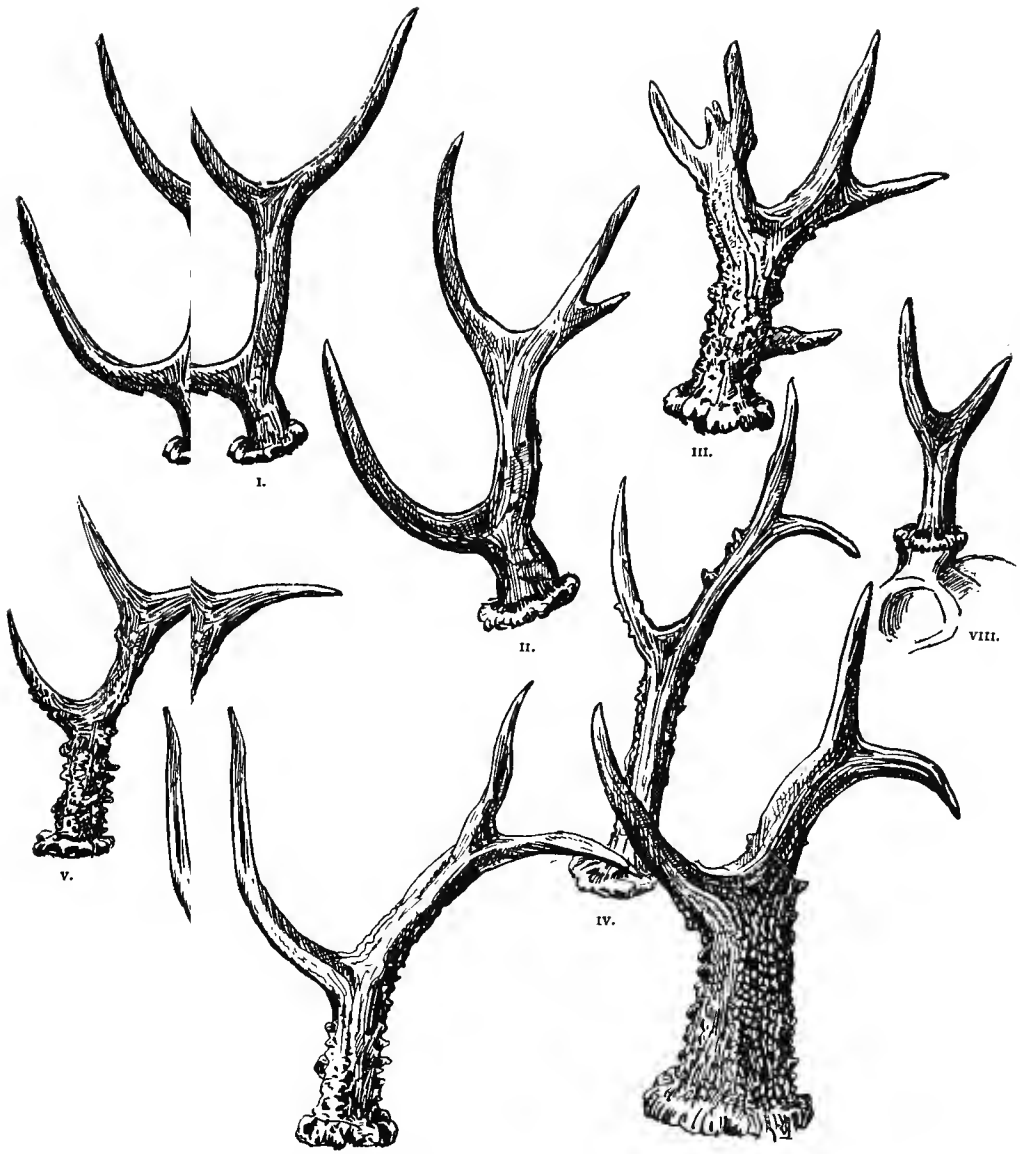
very long. These coarse hairs are but loosely implanted, and easily come out. For a considerable proportion of their length they are purplish-gray, but within a short distance of the tip they turn either to reddish-brown or brownish-gray, according to the season. This variation of colour in the longer hair causes the animal's coat to look somewhat patchy and spotted at times by the purplish-gray becoming visible under the lighter surface of the tips. The colour of the roe, male and female, varies markedly between the winter and the summer season. About May the roe begins to assume its summer coat, which is a foxy-red all over, though slightly paler, perhaps, on the belly, the rump, and underneath the chin. Summer and winter alike, however, the roe retains a very distinct mark on the face. The naked skin of the muffle is black, and there are patches of jet-black hair on either side of the nose, on the outer edge of the muzzle, above and below the angle of the mouth. The front of the muzzle and the chin are pure white. This black and white nose and mouth gives rather an effective touch to the appearance of the extremely pretty head possessed by this deer. The hair inside the ears is yellowish-white, and the outer edge of the ear and the tip are black. In the winter, that is to say, between October and April, the fur is much thicker and coarser, and the general effect of colour is brownish-gray, the lower part of the hairs being much more of a blue-gray than the tip, which inclines to brown. The general effect over the greater part of the body is that of a dark brownish-gray, with a slightly reddish tinge on the shoulders, behind the ears, and on the limbs, while the brownish-gray strengthens almost into black as it nears the edge of the rump. On the rump itself and the loose prominent hair that juts out on either side of the stump of a tail there is a patch of pure white in the winter season, so that at this time the black line drawn across the muzzle on either side, the white lips, and the white stern make the roe somewhat conspicuous. In the winter season there is a tendency to white under the jaw, and on the throat of the roe this may sometimes take the form of a crescent-shaped band across the under side of the throat.

HEAD AND NECK OF ROEBUCK, TO SHOW WHITE MARKINGS ON NECK AND BLACK MARK ACROSS MUZZLE

These bands are very characteristic of the early white markings of Ungulates. The adult roe is unspotted, but young roes when first born are fully spotted with white, and have these white half-circles on the throat. The spots fade during the first year of the roe's life, and the patches of white on the throat only recur (more or less marked, sometimes very faintly) in the winter coat of the adult animal.

As in all deer, there is a prominent tuft of hair covering the gland on the hind legs just below the hock. The female roe is hornless except in abnormal cases, wherein, as happens so often among vertebrates, when the female loses her breeding powers she assumes something of the characteristics of the male. Under these conditions the female may produce an aborted antler. Mr. J. G. Millais, however (who in his *British Deer and their Horns* has produced a classic work on the subject), quotes a German writer in the *Field*, who asserts that female roe deer may produce antlers without being either unsexed or barren. He alludes to many cases in which does with horns were prolific and dropped and suckled fawns. This is interesting as showing how such a condition as the reindeer could be brought about, wherein the female now invariably grows antlers. These would begin as sports, as quite exceptional instances, such as they are in the roe, and gradually, if circumstances (such as the protection of the young) rendered it necessary, would become universal. The most primitive types of cattle (now extinct) only produced horns in the male, and this is the condition of most antelopes; but in modern cattle, in two genera among the Tragelaphs (the eland and the bongo), in the sheep and goats, gazelles, oryxes, and hartebeests, the female is always horned.

The antlers in the male roebuck vary considerably in length, girth, and number of points, not only as between the two species (those of Europe and Siberia), but also between Scottish and English examples, existing and fossil. The average roebuck's horn is as depicted in the drawing on p. 295. Other types are illustrated on p. 297. In some roe deer the tubercles of bone which appear on the lower half of the antler become



EXAMPLES OF ROE DEER'S ANTLERS, ANCIENT AND MODERN.

I. and II. From Scottish peat and gravel (Pleistocene).
III., IV., V., and VI. Modern Scottish heads.
VII. Type of "mossy" thick antler.
VIII. Example of antler in female (aberrant).

so exaggerated as to produce a "mossy" appearance, which may stamp the whole outline of the horn. The typical roe antler rises some 4 in. or 5 in. from the coronet[1] (in some cases nearly vertically from the head), and then forks. The front prong of this fork might very well answer to the brow antler of the typical stag, and no doubt is the same in origin. The antler then slants backwards after the first fork, and forks again, the lower prong of the second fork pointing downwards. This, therefore, gives an average roebuck horn three points. But in past and present specimens of this deer there can actually be six points (a not uncommon extravagance), or even, in abnormal heads, eight. Occasionally the first fork of the antlers is so low down that there is nothing to distinguish the front prong in position from the true Cervine brow antler.

The extremest length of a roe antler measured along the outer curve to the tip of the furthest prong is 13 in. (for a British specimen), the finest known heads on the Continent or in Tartary perhaps reaching 2 in. farther. But normally good heads of the roe in England rarely exceed 11 in. The girth of the horn round the coronet may be 7 in. in excessively thick horns, or more when they become monstrosities. The ordinary girth round the base of a good horn is about $5\frac{1}{2}$ in. Besides other eccentricities roes occasionally produce three horns, an extra horn sometimes appearing in the middle between the two normal antlers, or at the side, and slightly nearer the brow. Sometimes the two normal horns (which in any case are not very wide apart) grow together and fuse into a solid mass. One feels, in short, that as regards antlers, at any rate, the roe is still in such a plastic state that it might go on originating new species. Undoubtedly it stands very near a primitive type of deer, which might be at the base of several widely divergent existing forms. From its horns and the bones of its side toes and the anatomy of the male generative organs, it is in any case thought to be closely allied to

[1] The "coronet" being that spreading-out of the base of the antler where it starts from the bony pedicle.

that somewhat abnormal (Dorcelaphine) group of American deer represented by *Dorcelaphus* and other genera.

The roe deer at the present day exhibits two sub-species or species. There is the common roe, indigenous to Great Britain, Europe, and Western Asia, and there is the Siberian roe (*Capreolus pygargus*), which is a decidedly larger animal, with a somewhat less abbreviated tail. The antlers of this roe can occasionally become quite palmated. There is also said (though this is doubtful) to be a third variety or species—the Manchurian roe, which agrees in most particulars with the European, but differs somewhat in coloration. The present area of distribution of the European roe is the greater part of Europe (including the south of Sweden), and parts of Russia, the Caucasus, and Asia Minor. The roe is not indigenous to Ireland, and no fossil remains of the animal have been found as yet in Irish deposits. It exists in Ireland at the present day in the county of Sligo, in the north-west, but it has only been introduced there for a hundred years. In one or two other parks of Ireland it was also kept, but it does not seem to flourish in that country. There are said to be still a few indigenous roe living in parts of Cumberland descended from the old English stock, but elsewhere in England the roe became extinct early in English history. In Wales the wild roe lingered down to the end of the sixteenth century. When the owners of parks began to take an interest in the native fauna, attempts were made at the beginning of the nineteenth century and onwards to reintroduce the roe. A flourishing colony of them was got together in Dorsetshire, mainly on the estate of Milton Abbas. It is here that the present writer has seen most of the roe, and his coloured drawing is made from sketches of roe in the park of Milton Abbas some years ago.[1] The roe, however, has remained continuously a native of Scotland from the Pleistocene period. Here they are still found in the Highland districts, away from the farming and industrial localities.

[1] There are roe deer now in the New Forest, at Virginia Water, in Epping Forest, and in several parks in Sussex, Surrey, Wales, and no doubt elsewhere.

The male roe deer drop their horns towards the end of December, and by the end of February the new antlers are nearly perfect. Roe are monogamous, unlike so many other deer. The bucks begin to seek the does soon after the fawns are born in June. In July the male presses his attentions closely on the female, and at this time they are especially eager at their racing rings. With the roe, as with several other deer and antelopes, there is a practice of resorting to certain fixed places—open glades generally—where they race round and round in a circle until regular tracks are made, sometimes in loops, sometimes in other circular shapes. Their resort to these rings during the breeding season is constant. The female will allow herself to be pursued by the male sometimes till both are exhausted for want of breath. It is not until the beginning of August, as a rule (in Scotland), that the rut, or actual breeding season, commences, though this may be as early as July in Dorsetshire. Does that have not been fecundated sometimes invite once more the attentions of the male in October. But the remarkable and apparently now well-established feature in the breeding habits of the roe is this, that assuming the female to have become pregnant in August, the embryo remains dormant and of minute size until the end of December, when its development proceeds at a normal rate, and the fawn is born in England during the month of May, in Scotland early in June. This is as yet an unexplained phenomenon, but it seems to be one that is well established by the researches of Professor Bishop and Dr. E. Ziegler, the German embryologist. The explanation possibly may be that the roe originated (as did most of the deer) in Eastern Asia, where its nearest relation, *Hydropotes*, still lives ; and that in a semi-tropical climate there was no risk in producing young early in February ; but that when the force of circumstances and competition with other forms pushed the roe into the northern regions of the Old World, and into a Glacial age in full swing, this deer may have gradually acquired a power of retarding the development of the fœtus until it could be produced at the beginning of the summer.

The roe has a voice and uses it, especially during the breeding season. The male utters a loud bark, a sound sometimes more like a bleat or a harsh yelp, often resembling the cries of a dog. The female is more silent, but during the breeding season (writes Mr. Millais) "she gives an amorous call when she wishes the male to come to her. If he is within hearing he puts out his neck straight and comes at full speed. . . . In Germany many roebucks are shot by alluring them in this manner, and calls exactly imitating the voice of the female are made for the sportsman's use."

Though a relatively small animal, the roebuck can be very fierce, and the male in the rutting season is excessively dangerous, as he can kill a man with his sharp horns. Several instances are known of men and boys meeting their death in this manner. The female will defend her fawn against dogs, and sometimes even men, by striking out with her sharp-hoofed fore feet, and even butting with her forehead. The male also strikes out with his feet in his own defence. But in this respect roe deer do not find their hoofs such effective weapons as is the case with the red deer, the elk, or the reindeer.

The food of this little deer is grass, leaves, fungi (which they scent and dig up), and (among other fruits) rowan berries, of which they are passionately fond. To reach these they will often stand on their hind legs, supporting themselves for a time by leaning the fore feet on some low branch or against the trunk of the tree.

Alces machlis. The Elk, or Moose

It has already been stated that the gigantic extinct Broad-horned Elk (*A. latifrons*) was a British beast, and mainly confined in its range to Britain. The elk which at present exists in Scandinavia, Siberia, and parts of North America was probably also an inhabitant of Great Britain not longer ago than some ten thousand years. Antlers and bones, apparently belonging to *Alces machlis*, have been found in the Pleistocene and superficial

deposits of North Wales, Northern and North-eastern, Eastern and Central England, as far south as Essex. In Scotland the remains are abundant, especially in the east, south, and south-west. In Ireland its existence is argued from some fragments of antler and bones found in County Tyrone.

The elk is a very isolated, and in some respects specialised, form of deer. Such resemblances as it does offer to other creatures of the same group lie in the direction of the American deer of the sub-family *Dorcelaphinæ*. The bones of the side toes are (as already mentioned) like those of the reindeer, the roe, and the American group; only their lower portions are retained. The antlers are very big. Their beams grow horizontally and almost at right angles to the line of the neck ridge and forehead. The pedicle is very low. The round unbranched stem or beam of the horn is rather long in some extinct species, and then palmates broadly. The palmated part of the horn is divided conspicuously into two main portions. One, the nearest to the skull, contains about five prongs in the mature male. The palmation then continues in a direction almost at right angles with the round, lower stem of the antler, and along the edge of this palmation project as many as twelve or more prongs or points in well-developed antlers. It is thought by that great authority, Mr. Lydekker, that there are some slight resemblances in the arrangement of the elk's antlers to the horns of the American group of deer. It is possible that the elk may have originated in North America from a stock which produced the American sub-family, itself a development, very likely, of an Old World roebuck origin.

As the elk has been so long banished from these islands as a wild species it is not necessary to describe it any further. Perhaps the British climate has changed disadvantageously from the elk's point of view in ten thousand years, for attempts like those made by the Duke of Bedford to acclimatise and reintroduce the elk have been unsuccessful, apparently for climatic reasons.

Rangifer tarandus. THE REINDEER

The Reindeer belongs, as has been already mentioned, to that group of deer (*Telemetacarpalia*) which only retain the *lower* ends of the metacarpal bones of the second and fifth toes; though occasionally in the reindeer there are minute fragments near the wrist joint of the upper portions of the second and fifth metacarpals which are so well represented in their lower portions. Antlers are present in both sexes —an exceptional instance in the Deer tribe—but it is said that this is not the case amongst all the breeds of reindeer, and that the females of those found in North-east Russia are hornless. The head is rather coarsely built, with a big muzzle, which certainly offers a suggestion of the elk about it. The ears are not long, are rather rounded, very hairy, and white in colour fringed with black. The general colour of the head, especially along the ridge of the nose, is also blackish. In colour the rest of the body varies a good deal according to the season, but in June it is a pale yellowish-gray on the neck (including the thick fringe of hair that lines the edge of the throat), a bluer gray on the body, with a tinge of warm brown in the gray on the hind quarters. There is a blackish stripe along the edge of the flanks and the belly is whitish. The front limbs are blackish-brown, and this tint marks very strongly and decidedly the inner sides of the hind legs, with a whitish patch on the inside of the hock, and whitish lines on the edges of the hoofs. The tail, which is distinct though short, is also fringed with white, and there is a little white on the buttocks. These tints vary according to the different races into which the reindeer is divided. The female is rather darker and the young are darker still,[1] with a blackish line along the back. The limbs are distinctly short in comparison with the length of the body, shorter proportionately than in any other big deer. The feet are clumsy-looking

[1] Except when first born and quite young: then they are pale yellow-brown.

and large, with well-developed false hoofs and very large splay main hoofs.

The antlers are of remarkable appearance, but vary a good deal according to race. They rise from low pedicles just behind the eyes, and close to the junction with the pedicle throw out two long palmated tines, which overhang the long nose, lying almost parallel with it in forward direction. A short distance above the point at which these frontal tines branch forth over the nose rises another tine, also palmated. Then comes (in some forms) a great sweep of smooth, round antler, which only throws off on the under side one small tine before it gives the final palmation. In one of the Arctic American types the horns may be much simplified. The second tine above that which grows over the nose is a simple prong, and not palmated, and grows so close to the frontal tine as to be partly fused with it. The beam of the rest of the horn is extremely long before it is broken by the final tines, which are but little palmated.

It is very difficult to classify the reindeer type of antler, or to say from what more primitive stock it was derived. It is quite conceivable that it could have been derived from the same type of antler (such as in the extinct *Cervalces*) that gave rise to the horns of the elk. The position of the frontal tines suggests relationship (probably quite fallaciously) with the Elaphine (red deer) group. On the whole, perhaps, the reindeer's nearest relation is the elk. It is rather an old type of deer, and made its first appearance early in the Pleistocene period, but apparently a little later than the elk, traces of which are to be met with in the Pliocene. The present distribution of the reindeer is confined to Sweden and Norway, Russia, Siberia, Spitzbergen, the Arctic regions of North America, Greenland, Northern and Eastern Canada, the extreme north-eastern part of the United States, and Newfoundland. The range of the reindeer in Europe was very different a few centuries ago. It was still found along the southern shores of the Baltic in the sixteenth century, and about the same time in Poland. At the beginning of the Christian era it was (on the authority of Cæsar) met with as far south as the

Black Forest in Southern Germany; while further back still in Prehistoric days it extended right across France, almost to the Mediterranean and to the base of the Pyrenees. In these Prehistoric days, also, it inhabited the whole of England, Scotland, and Ireland. In the last-named country it is the opinion of Dr. Scharff that the type of reindeer met with was that still found in the Arctic regions of North America, while the reindeer of England and Scotland he believes to have been identical with the Scandinavian, or "Woodland," form. He supposes, therefore, that the Arctic American type of reindeer, travelling *viâ* Greenland and Iceland, over a then continuous land (or ice) surface, reached the north of Scotland and so passed into Ireland; while England and Southern Scotland were peopled with reindeer from France and Belgium, of the type still found in Scandinavia.

It has been thought by some authorities that, although the reindeer died out long before the Historic period in England, it still persisted in the extreme north of Scotland down to the close of the twelfth century; and they support this opinion by quoting the history of Torfæus, a Dane, who in the seventeenth century put together a History of Orkney from translations into the Latin of the Norse sagas of Orkney. An Icelander named Jonæus again translated these sagas into Latin in 1780, and commented on Torfæus's History. According to him, the correct phrase (he gives the original Norse) might be translated into English: "The Jarls of Orkney were in the habit of crossing over to Caithness almost every summer, and there hunting in the wilds the Red Deer and the Reindeer." I see no reason to doubt the probability of this statement. As Professor Boyd Dawkins points out, the red deer had probably advanced little by little on the reindeer, taking possession of their pastures (aided by the milder climate), until at last all that remained of the British reindeer were crowded into the northern extremity of Scotland, and so gradually became extinct before the attacks of man and the rivalry of the more successful red deer.

It is generally considered now to be probable that the reindeer as a genus originated in North America, like the elk; and that

it made its way *viâ* Behring Straits (then dry land) into Siberia, and so reached Western Europe. Dr. Scharff considers that a second invasion of Europe by the reindeer took place when that small form known as the Barren Ground race (*Rangifer tarandus arcticus*), with long slender antlers possessing but few points, journeyed to Northern Scotland and Ireland by way of the land bridge, or by the ice then joining Scotland with Iceland and Greenland.

The reindeer (no doubt as an article of food) made a profound impression on primitive man in Northern Europe, and is often portrayed by scratches on bone or ivory, or on the sides of caverns. A capital picture of a reindeer from the cave of Combarelles, in Dordogne, indicates a type of antler much like that of the Barren Ground variety. The Woodland form of reindeer does not seem to have arrived in Britain till the close of the Glacial phase. It soon swarmed over the country, leaving almost more remains than have been left by any other extinct beast. It specially abounded in the valley of the Thames, in Wiltshire, Kent, and Somerset. There is reason to suppose that it may even have lingered in parts of Britain when the Romans arrived here. Its fossil remains are found all over Scotland. As already mentioned, remains of the reindeer are also abundant in Ireland; but, in common with some found in Western Scotland and Northern France, they appear to indicate a type similar to that now dwelling in Arctic America. In England it was apparently fiercely attacked by the cave lion and the spotted hyæna; no doubt also by the great cave bear and by the wolf.

GENUS: *CERVUS*. THE TYPICAL DEER

This large genus, together with allied genera of the same group, belongs, as already mentioned, to the Plesiometacarpalian division, in which the lost toes (second and fifth) are represented by the upper ends of their metacarpal[1] bones close

[1] The metatarsal fragments on the hind limbs are rarely found.

to the wrist joint. These side toes, however, in the typical deer are also supported (and perhaps sufficient stress is not laid on this fact by zoologists) by a few bony phalanges at the extremities. The antlers of the typical deer invariably possess (even if it has only degenerated to a rudiment) a brow tine, which, rising quite close to the coronet, or commencement of the antler, extends more or less horizontally over the forehead, often in a line nearly parallel to the profile of the nose. As a general rule, in the typical deer this front tine is never forked, the exception to the rule being in the extreme types of *Cervus giganteus*, that giant deer of Europe and Ireland. The skin round the nostrils and middle of the upper lip is naked and wet. A gland on the hind leg, which is a feature in so many deer besides this genus, is present (concealed by a tuft of hair) on the outer edge of the metatarsus—that is to say, on the lower part of the leg just below the hock ; and there is no gland in the inner side of the hock, such as exists in the American deer. The males of this genus may or may not possess small canines in the upper jaw. Occasionally these teeth make their appearance in the female as well. They have, however, lost all importance in this genus, and are practically no longer functional. The females have four mammæ. The genus *Cervus* is divided by Lydekker and other authorities into the following groups or sub-genera: (1) The Red Deer, or Elaphine; (2) the Sikine, or Sika Deer (found in Eastern Asia, and the stock from which the Red Deer group arose) ; (3) the Damine, or Fallow Deer group; (4) the Rusine, or Axis-sambur group ; and (5) the Rucervine, or Swamp Deer group. As already stated, it is believed that a species of Axis Deer (*Cervus suttonensis*) inhabited England during the early Pleistocene, and some of the scarcely defined earlier species of deer in this country may possibly have belonged to the Sikine[1] group ; otherwise the only two groups of deer which are represented with any certainty in the British fauna are the Damine (Fallow Deer) and the Elaphine (Red Deer).

[1] They certainly existed in France, where one species has been classified as *Cervus perrieri*.

Cervus dama. The Common Fallow Deer

The existing fallow deer are divided into two main types: the first (rather larger than the second) becoming in the summer-time of a light reddish-gray (or light reddish-brown), spotted more or less brightly with white, the legs and belly being cream-colour or a pale buff. The neck is of the fallow or reddish-gray of the rest of the body, with or without spots on its lower portion. There is generally a black line right down the centre of the back from the shoulder to the tail, and this black is prolonged to the very end of the upper surface of the tail, the under surface of which is white. The rump under the tail is white, edged by a blackish line on each side. This first type of fallow deer changes the spotted coat in October, and throughout the winter its pelage is on all the upper surface of the body a dark uniform brown, while the belly and legs are a pale grayish-brown. The black and white markings of rump and tail are retained. The head of this fallow deer has white lips and chin and whitish edges to the jaws. The inside of the ears is whitish. There is generally a black mark (as in the roebuck), beginning near the end of the angle of the nostrils, descending to the angle of the mouth, and crossing over to the edges of the lower lip. In many specimens of the spotted fallow deer no spots are discernible above the shoulder on the neck, but this is certainly not the case with all, as may be seen not only by the author's drawing, which is done from life, but in a photograph, which is given to illustrate the different varieties of fallow deer. If this photograph is looked into carefully, it will be seen that in bucks and does, where there are spots at all, the spots extend on to the lower neck. Moreover, some of the photographs of fallow deer given in Mr. J. G. Millais's *British Deer and their Horns* also show indications of spots on the neck. The author has even seen slight indications of spots on the cheeks of some male fallow deer. It is, perhaps, necessary to insist on this point, because it is often asserted that spots in this species *never* extend beyond the shoulders. It is, of course, rare for deer

Photo by C. Reid.

FALLOW DEER (*Cervus dama*).

Photo by the Scholastic Photo Company.

FALLOW DEER (UNSPOTTED FORM).

To face p. 308.

to be spotted on the neck, but this feature occurs in the axis of India.

The other type of fallow deer in England is much less handsome. It is slightly smaller than the first described, and is entirely without spots. The belly, the inner side of the neck, the muzzle, and the limbs are pale, sometimes a buff-white. The under surface of the tail and the stern are white, with the black border as described in the other form. The colour on the neck and body either becomes a dark brownish-black or even quite black (generally darkest in summer); or the brown becomes quite a chestnut or vinous-red, the neck, however, remaining blackish. There are, of course, white and other varieties of the fallow deer produced in a domestic state, from which the true lover of nature turns away wincing, just as he would do from any other non-natural type perpetuated by man's protection.

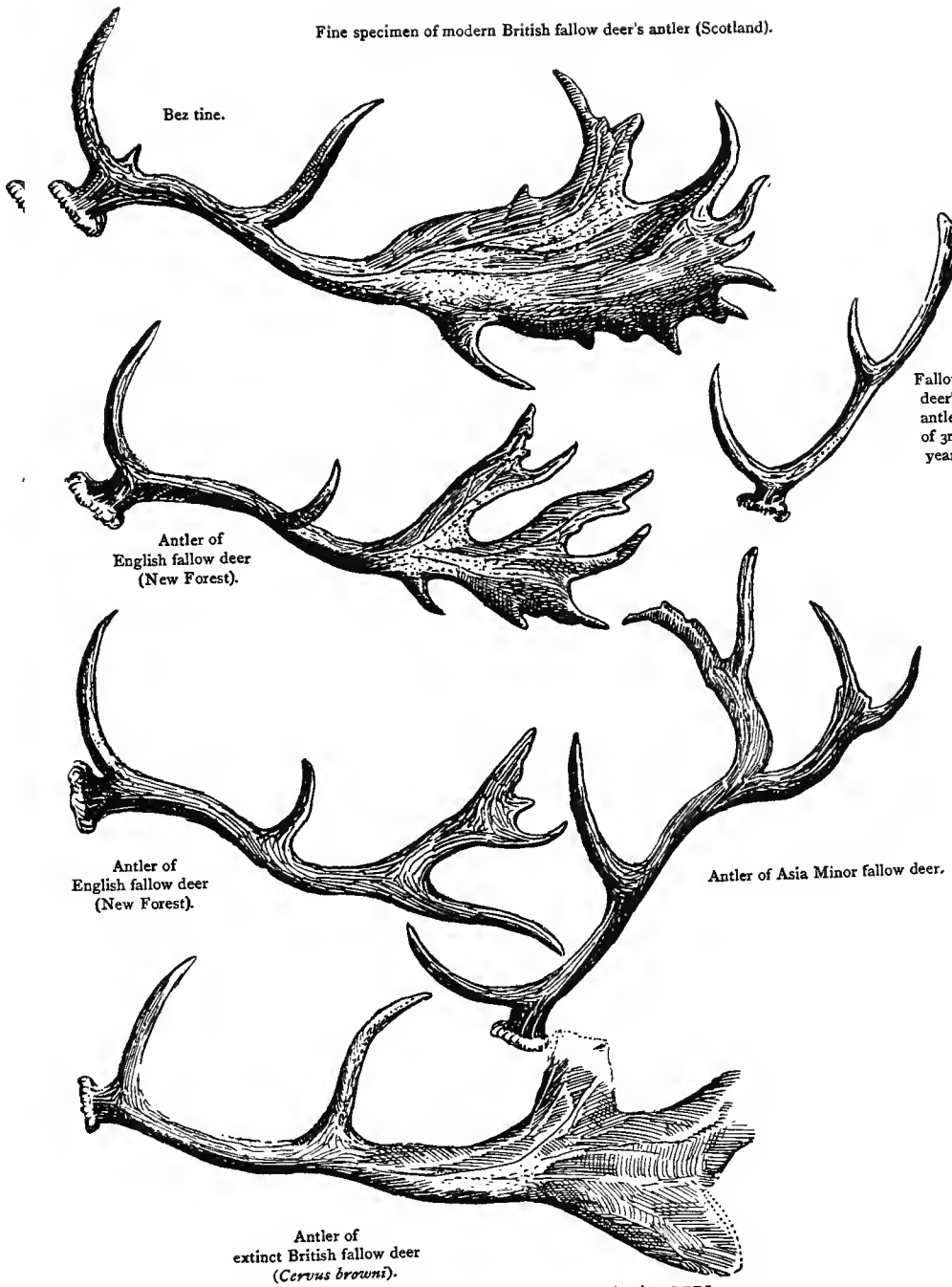
Fallow deer have a tail covered with rather long hair. It is about 6 in. in length, and sometimes longer. In this length of tail they differ markedly from the very short-tailed red deer. They have another peculiarity. The penial sheath is marked with a plume or fringe of dark hair. This feature occurs independently in the oxen, but I cannot recall it in any other Ruminant, though there is a bushy growth round this organ in the roebuck.

The height of a good buck of the larger variety of fallow deer may be as much as from 39 in. to 40 in. at the shoulder, but fallow deer in these islands rarely stand higher than 36 in. at the withers, and a little less in the females. The smaller plain-coloured type is about 34 in. in the same measurement. The antlers of this sub-genus are specially remarkable for their palmation; that is to say, the spaces between the tines are filled up by a broadening of the bone. There is a tendency to palmation inherent in the Deer family which crops out quite independently in different genera. It occurs, as we have seen, in the elk, and in a lesser degree in the reindeer. The horns of the red deer have a distinct tendency towards palmation. In the big fallow deer found on the western coast of Asia Minor the palmation

is almost unobservable, and I give a drawing of one of the horns of this deer (together with illustrations of the other types) to illustrate this important point; for there is no doubt that no undue stress should be laid on palmation in the classification of this group. The Fallow Deer sub-genus, however, does differ somewhat markedly from the Elaphine and Sikine deer, in that its antlers are usually lacking in the bez, or second tine.[1] But this does occasionally make its appearance in a short knob, or prong, close to the brow tine. In the Persian fallow deer the brow tine is often reduced to a mere knob.

For the origin of the fallow deer we must hark back to Asia, as we have to do with more than two-thirds of the British Mammalia. It is evidently allied in origin to the Sika group. At the present day one species of fallow deer is found in Western Persia, while a large fallow deer, which is sometimes nearly the size of the red deer, but is apparently identical with *Cervus dama*, still lingers on the west coast of Asia Minor. Fallow deer of much the same type are found at the present day in a wild state in Northern Palestine, in the island of Rhodes, in Greece, Sardinia, Spain, and Portugal. The fallow deer in Italy are said to be introduced. The fallow deer in the south of Sweden are of that insipid dark brown variety which is also met with in England. These, too, are said not to be indigenous. Lastly, the fallow deer, spotted and unspotted (the spotted form bearing a remarkable resemblance, except in size, to the fallow deer of Asia Minor) is found in England and Scotland. As to whether existing fallow deer in Great Britain are descended direct and uninterruptedly from the wild fallow deer which we know inhabited these islands in Prehistoric times, is still a matter of dispute. The fallow deer of Scotland and of the New Forest bear many signs of being wild animals, and not the descendants of tame ones. On the other hand, it is asserted

[1] The tines, or branches, of the Cervine antlers are known by the following names: The first is the brow tine, the second the "bez" (pronounced "bay"), the third the "trez" ("tray"), and the remaining tines in the terminal group the "cup."



EXAMPLES OF FALLOW DEER'S ANTLERS.

that the spotted form of the fallow deer was reintroduced into these islands (after it had become extinct) by the Romans, and that the dun-coloured variety was brought here at some time or another from Sweden. With regard to the last-mentioned introduction, it is certain that King James I. did import dun-coloured fallow deer from Sweden, no doubt to reinforce the existing stocks; but there is historical evidence to show that the dun-coloured variety existed in England long before the time of James I. It may or may not be descended from a wild stock.

The author fails to see, however, that any sufficient proof has been brought forward to show that the spotted fallow deer are entirely descended from pet animals introduced by the Romans. Why should the Romans have given themselves the trouble of conveying fallow deer right across France to establish them in England for the future puzzlement of zoologists? The Romans, in the last days of the Empire, were fond of keeping birds and beasts in a tame or semi-tame condition, but this practice refers rather to their life in Italy. To them has also been ascribed the introduction of the rabbit and of the pheasant into these islands, as well as that of the white water-lily, the elm, and several others of our now native trees and plants. The white water-lily certainly is an introduction: whether by the Romans or succeeding civilisers is uncertain; the elm also. But Dr. Scharff and other recent writers have combated with some force the idea that Great Britain owes rabbits, fallow deer, and pheasants to these fastidious conquerors. There is every reason to believe that the pheasant (which as a wild bird may have died out in France, but has certainly persisted as such in Transylvania, and the fossil remains of which are found in France dating from the Pleistocene period) did find a refuge in the forests of England, where it lingered on as a scarce wild bird, until it was taken up and encouraged to increase and multiply for purposes of sport a hundred years ago. The case of the rabbit was dealt with on p. 214.

The fallow deer cannot be considered native to Ireland, the few that are found in that country having been quite recently introduced from England.

The male of the fallow deer casts his antlers in May (in the case of the bucks of the first and second year, not till June). By the middle of August the new horns are almost free from their "velvet." It should be noted that, as regards the length of time in which a fallow buck grows his new antlers, he accomplishes this growth at a quicker rate than the red deer, in whom there is generally an interval of five months between the shedding of the horn and the presentation of the perfect antler stripped of its skin.

The shape of the fallow deer's antlers seems to interfere somewhat with their value as deadly weapons. When the bucks are sparring, the flat, bony basins of the horns make a loud-sounding clashing, and no doubt they can hustle and push one another about very roughly, but there is scarcely any prong or portion of the horn so constructed as to be a good stabbing weapon. For this reason, also, fallow deer are best suited to be park animals, because they are mild in disposition and practically harmless. They have neither the savage boldness (at times) nor the stabbing antlers or powerful feet of the roe deer or the stag.

Fallow deer do not make so much use of their voice as the roe or the stag. The females are generally very silent, and the male only utters a grunting bark occasionally during the rutting season in September. Only a single fawn is produced as a rule, twins being very rare. The fawn is born in June. Fallow deer are always gregarious—that is to say, they do not go about in couples or alone, but for the greater portion of the year the sexes separate, the bucks being together and the does by themselves, with their young. But the small parties of males, or of females, generally coalesce into large herds in August and September, and again during the beginning of the winter. This last congregation (in the winter-time) is no doubt a relic of the days when at that season they were forced to band together in large numbers

(males and females) to protect themselves from the ravages of wolves and other carnivorous beasts.

In winter they feed on such grass as they can find, and on leaves and twigs; but it is doubtful whether, during the present conditions of disforested England, the fallow deer, if allowed to run completely wild, could survive the winter without starvation. Therefore, in all parks and forests where they are now kept, they are supplied during the winter-time with a certain amount of hay and corn. Fallow deer are very fond of horse-chestnuts, which they eat greedily during the autumn; standing up on their hind legs to reach the boughs, striking at the boughs with their front feet and horns in order to knock off the chestnuts. This fondness on their part for the fruit of a tree which is a recent introduction from Asia Minor, certainly might suggest to some the idea of the fallow deer itself being an introduction from those parts. But it is quite possible that the liking for this food could be independently acquired in England.

Cervus browni. Brown's Fallow Deer

This, together with *Cervus savini* (which may be a varying form of the same animal), was a fallow deer of the early type, with simpler antlers, which inhabited, at any rate, the east of England during the Pleistocene Epoch.

Cervus giganteus. The Megaceros, or Gigantic Deer

(Also incorrectly known as the "Irish Elk.")

This magnificent creature, the males of which stood at least six feet high at the shoulder, is little else than a gigantic development of the fallow deer type, greatly as it differs in appearance from the fallow deer of our parks. We have had to trace so many examples of the mammalian fauna of these islands, and of Europe, back to Asia for their origin, that it is a gratification to be able to suggest that this culminating triumph of the deer tribe was probably born within the limits of Europe. Nevertheless, it is not absolutely certain that Siberia may not have been

From a drawing by the Author.

Photo by W. P. Dando, F.Z.S.

Photo by W. P. Dando, F.Z.S.

THE GIGANTIC IRISH DEER (*Cervus megaceros*): ANTLERS AND SKELETON.

To face p. 314.

its original home. The probability is, however, that in the early part of the Pleistocene period a species of fallow deer very like the one above mentioned (Brown's) developed under very favourable circumstances in Central Europe into a deer of considerable size; no doubt in the absence of rivalry with the red deer type, which had not at that time developed from the Sikas, or taken complete possession of the temperate regions of Central Europe. This enormous fallow deer migrated westwards, and in France and England assumed the form we designate as the Forest Bed race—*Cervus giganteus carnutorum.* This is apparently the same form as *Cervus verticornis* and *C. dawkinsi*, the horns of these deer only offering such variation from the French form *C. g. carnutorum* as is explicable by local variation, or the different age of the antlers. In Germany the gigantic fallow deer assumed a type which we know as *Cervus giganteus ruffi.* In Ruff's deer the antlers are smaller and less palmated than in the British race. In Italy, however, and not in Britain, may be found the earliest link between the fallow deer and the gigantic form; for in that country and in Hungary the *Cervus giganteus* was not much larger than the red deer, the antlers were comparatively simple, with narrow palmation; but the back twist of the horns, which almost brings the outer surface of the "palms" into sight from the front and not from the side, and some other features, rather point to a case of degeneration, The *Cervus giganteus* was also represented in France by the variety called *belgrandi*, but this form is hardly separable from the form described as *carnutorum* (*dawkinsi*, *verticornis*).

But the grandest development took place in Britain and Ireland. *Cervus giganteus typicus*, the typical Megaceros, or Gigantic Irish deer, was probably developed first in England. It also spread to the north-west of Scotland. From here it passed over to Ireland, where, partly owing, no doubt, to the absence or scarcity of man, and to the non-existence of great Carnivores, such as the lion and sabre-tooth, it had the whole island or the Hibernian Peninsula to itself, and reached its acme of magnificent development. It will be noticed that there is

absolutely no trace of the bez, or second tine, on the horns,[1] and that the brow tine tends to be very short and to assume palmation, while alone amongst the deer it forks into one or more prongs (though, of course, there are some examples in which it is simple). In fact, the brow tine of this deer resembles that of the reindeer. Occasionally the brow tine is not only divided, but is much bent down over the face. Sometimes, instead of branching out into a "palm," it merely forks into two short prongs. In Mr. Rowland Ward's book on big game measurements, 11 ft. 6 in. and 11 ft. 3 in. are given as the greatest recorded measurements of the horns of the gigantic Irish deer from tip to tip. The length along the inside curve of one of the antlers, which measured 11 ft. 3 in. from tip to tip, was 7 ft. $5\frac{1}{2}$ in., and the measurement across the greatest width of palmation was $19\frac{1}{4}$ in. This antler contained seventeen points. The greatest recorded width of palmation is 25 in. The greatest recorded number of points in a megaceros antler is twenty-eight, and apparently the greatest length measured along the inside curve that has been recorded is as above stated, 7 ft. $5\frac{1}{2}$ in. Mr. Millais mentions a head which measured 11 ft. 3 in. in span from tip to tip, but his own measurements of some of the finest heads in the world, which are exceptionally careful, give no greater spread than 9 ft. 5 in.

The females of the gigantic fallow deer were hornless. The vertebræ of the neck, in the male especially, were greatly enlarged and strengthened to bear this splendid burden. There were no canine teeth developed in the upper jaw. The tail was slightly longer than it is in existing fallow deer. We can only now make inferential guesses at its hair and colour. It is improbable that it became hairless in our cold climate; it may even have become shaggy. Unlike the pigs and bovines, the deer show no tendency towards loss of hair. The magnificent megaceros may have added to its splendour of antlers by a heavy throat mane. It may also have retained the white spots and the red-gray colouring of the fallow deer; but, judging by analogy,

[1] A fallow deer feature.

it probably became one-coloured in its maturity like all the big deer, though the females and young may have shown the white spots.

The megaceros in England was certainly co-existent with the earliest types of man that arrived in Britain, but it disappeared soon after their arrival, no doubt in consequence of the attacks that were made on it as an article of food, but also because at that time there existed in Britain enormous lions, and one, if not two, forms of sabre-toothed feline. The megaceros does not seem to have thriven much in Scotland, or to have existed there in any great numbers. Indeed, up to the present its remains have only been found in Ayr and that portion of Scotland which approaches nearest to Ireland, and where the last land bridge existed which connected Ireland with Great Britain. Across this bridge the gigantic fallow deer travelled, and found in Ireland its last home. In this almost-island, separated then from England and Wales by the Irish Gulf, but connected still with the south-west of Scotland by a bridge which included the Isle of Man,[1] the grandest culmination of the deer tribe found itself at first with no worse enemies than the wolf or the bear. When Ireland became finally insulated at the close of the Pleistocene period, only three causes could have brought about the extermination of the megaceros: (1) It may have become so over-specialised that sterility ensued. It generally seems to occur in such instances as where much-specialised types are cut off by the sea and obliged to lived on an island that unless they degenerate into a dwarfed form they die out from increasing sterility on the part of males and females. The extravagance in antler growth on the part of the males of these deer may actually have reacted unfavourably on the generative powers. (2) The massing of these huge deer may have caused the development of some bacillus, which, like the poison conveyed by the mosquito or the tse-tse fly, caused a disease leading to their rapid extermination. (3) Probably the last and most effective agency was the British sportsman (if I

[1] In which locality the megaceros existed in some numbers.

may apply the term British to anything that grew up in Ireland). The earliest types of Palæolithic man which reached Ireland from South-west Scotland, or from Wales, probably found the megaceros an easy prey with its unwieldy antlers. The great height of its head above the ground would have made it less observant of things that crept along the ground. No doubt it was done to death (as are big animals in Africa) more by falling into concealed pits, or by huge drives, which sent herds of megaceros tumbling over precipices or floundering into bogs, than by direct attacks on the part of man with his feeble flint-headed arrows, assegais, or axes. A good deal of doubt has been thrown of late on the question as to whether the megaceros survived in Ireland down to the Neolithic period; but that it did so seems probable, in spite of the absence of that absolutely conclusive evidence which in France (and also, perhaps, in Belgium) shows that the gigantic fallow deer was constantly the prey and the food of primitive man.

Cervus elaphus. The Red Deer

The red deer is a member of the Elaphine group, which includes the grandest species of deer now living, the culmination of the type being, perhaps, the Asiatic or American wapiti. The Elaphine group arose in Asia, perhaps in Central Asia, from some Sikine form similar to those which now exist in China (*Cervus sika*), Manchuria, and Formosa. The most primitive example of the Elaphine group at the present day is probably Thorold's deer (*Cervus albirostris*), which occurs in Tibet, with perhaps an outlying variety in Turkestan. This form lacks the bez, or second tine, of the antlers. The next most primitive form (in which the heart-shaped patch on the rump so characteristic of this deer is much less conspicuous in the summer-time) is the Duke of Bedford's deer (*Cervus xanthopygus*).[1] In the Duke of

[1] This word of course means yellow-rumped, because the caudal disc or the large light or white patch on the rump so characteristic of the Elaphine deer is a bright yellow in this particular species during the summer season.

Bedford's deer the bez tine is poorly developed, and the antlers are of simple construction and with a "cup" at the extremity.

Professor Scharff, of Dublin, is of opinion that the earliest of the several types into which the True Red Deer are divided is the present North African race (*Cervus elaphus barbarus*). This stag is distinguished from the other types of red deer by the rudimentary character or the absence of the bez, or second tine, of the antler. Its colour, like that of the Corsican deer, is scarcely to be described as red. It is more a dark brown, with a tendency to gray on the back, and with a retention of the white spots of the young on the flanks and hind quarters in some individuals. This earliest form of the red deer seems to have travelled due westwards from Asia Minor across the Mediterranean Basin, its journey, no doubt, taking place at a time when the distribution of land and water in the Mediterranean was very different from what it is now. Much of Italy was under water, and the Greek islands were the mountain peaks of a broad land which, with Greece, stretched across to Sicily, Sardinia, and North Africa. The small red deer (as this race may be called) still exist in Corsica and Sardinia, and in the Regency of Tunis and part of Algeria. They are probably extinct in Morocco, but seem to have inhabited that country at one time. The Spanish race of red deer, though it is really "red" in coloration, in some respects seems to be akin to the North African race. In the Carpathians, the Crimea, and the Caucasus, in parts of Asia Minor and Northern Persia, there is a red deer of the "maral" type, which, though belonging to the species *elaphus*, shows some affinity to the wapiti. This form connects the red deer with the great wapiti stock of Northern Asia and North America. It is excusable to mention the maral here, because this creature appears to have once inhabited Britain, where it preceded the typical red deer. The remains of its horns in English caverns by their massive character were thought by the late Sir Richard Owen to have belonged to a distinct genus of deer, to which he gave the name of *Strongyloceros*. But German naturalists and Mr. Lydekker have together shown, perhaps conclusively, that these

fragments of antlers belonged to a deer identical with *Cervus elaphus maral.*

The typical red deer seem to have reached the British Islands relatively late in the Pleistocene period, some time after the arrival of man. Professor Scharff thinks the first form to arrive was the small red deer from the Spanish Peninsula (see p. 319). This was followed by the big, normal red deer from Germany and Belgium. The red deer gradually displaced the "maral" type, and pushed the reindeer farther and farther north till it took possession of their feeding-grounds altogether. In Great Britain and Ireland the red deer, in Prehistoric times, developed antlers far more magnificent than any which are grown at the present day, except it be in certain cases of almost artificial park development.

The present habitat of the typical wild red deer is restricted to the following countries and districts:—In the United Kingdom it is found (wild) in the county of Kerry, in Ireland; on Exmoor (Devonshire and Somerset); in the Highland counties of Scotland and most of the great islands along the west coast of Scotland, including Harris, in the Hebrides. It is found on the island of Hetteren only in the kingdom of Norway, but it is also met with in the southern provinces of Sweden. In Spain it is fairly abundant, and perhaps in the border regions and the Serra d'Estrella of Portugal. But the Spanish race is thought to be more allied to the North African stock. Possibly it is the result of a fusion of both types, for the heads of deer which are shot in Northern Spain can scarcely be distinguished from the antlers of British or French stags of not over-good development. The red deer is found in France wherever it has been preserved, but it is hardly, perhaps, as near a wild state in any part of that country as it is in Scotland. It is extinct in Italy and in Switzerland. Germany and Austria are its best centres of development at the present day, and from those countries come the finest heads and the biggest stags. In fact, the British deer are being very much Germanised. Constant importations of stags from Germany and Austria during the nineteenth century have sensibly modified the

Photo by C Reid.

RED DEER . STAG (*Cervus elaphus*).

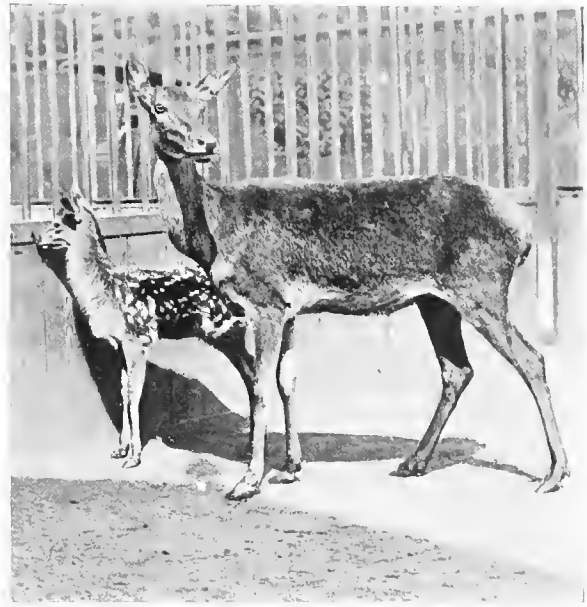


Photo by J. S. Bond.

RED DEER: HIND AND FAWN.

Photo by C. Reid.

RED DEER: HINDS.

To face p. 320.

size and antlers of the deer in English parks, and even the wild deer of the Highlands. The red deer is found in the Balkan Peninsula and in Northern Greece. In Asia Minor it merges into the maral. The same thing occurs in Hungary and Transylvania, where it is somewhat difficult to discriminate between the typical red deer type and the maral, which obviously holds possession of the Carpathians.

The True Red Deer is a large beast, the male standing 4 ft. at the withers, or even a few inches more, though in the case of the British stock a height exceeding 48 in. generally suggests park feeding or German intermixture. The hind is markedly smaller than the stag, and her height at the withers reaches in average specimens to about 43 in. The weight of a fine stag may be as much as 400 lb., but many greater weights than this are spoken of, perhaps without conclusive proof. In winter the colour of stag and hind is in general brown, with a good deal of gray about the neck and the face in the stag and the old hind. The inside of the ear is creamy-white (almost reddish in the stags sometimes), the outer edge of the ear being blackish. There is a tendency to a black stripe all down the crest of the neck and the back nearly to the root of the tail. This black streak is sometimes more obvious in hinds than in stags, and in the summer than in the winter. The hair on the belly is grayish-white in the winter and a pale ochre or reddish-yellow in the summer. The outside of the ear is a dark umber-gray. Seen at a distance, the black tips and edges of the ears and the whitish hair of the interior are a prominent feature in the hinds, and perhaps the most discernible part of the animal. Another important feature in the colouring of red deer is the rump, which exhibits (more markedly in the summer than in the winter) a heart-shaped area of pale ochre-yellow, broad near the base of the tail, and narrowing as it descends the hind quarters, which, as it nears the tail and the inner side of the buttocks, becomes almost white. There is a pinkish naked space under the tail, the tail itself being short, tufted, and thickly covered with reddish-yellow hair. As the hair of the hind quarters nears the edge of the

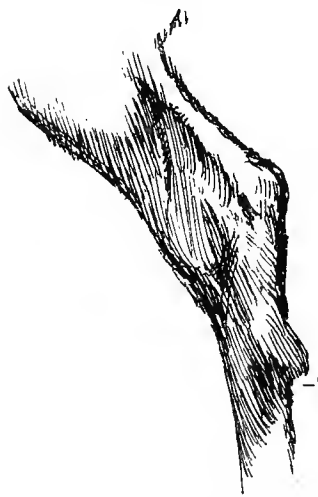
buttocks where the wide patch begins, it darkens almost to black, making an effective contrast with the great white or yellow patch on the rump. For the summer half of the year the red deer, in male and female, is really red over the greater part of the body; that is to say, the coat (except on the limbs, which remain umber-brown; on the belly, which is cream-colour; and on the neck and cheeks, where there is a good deal of grey) assumes almost a red-gold in healthy animals. On the back this gold deepens into purplish-black, and this purple element in the coat is apparent often in patches amongst the red-brown, and is due to the fact that the lower half of the coarse hairs of the red deer's coat is purplish-gray in colour. The neck, which is heavily maned on the under side and round the jaws in the male, and sometimes in the hind, is gray or umber on its under side and slightly more reddish or blackish over the nape. The head of the stag is rather brightly coloured in the summer-time. The forehead is almost red-gold, except where the purple end of the hair shows or where the red-gold is flecked with glossy black. The nose is blackish, and the hair, being very glossy, takes a blue or purple tinge according to the light. The cheeks are markedly gray. There is a light patch round the lower eyelids, and the lips and chin are whitish. At the angle of the lower jaw there is that characteristic black patch that one sees in so many deer. The nostrils and muffle are naked, wet, and black. The outside and front of the fore limbs is sometimes so dark a brown as to be almost black, especially near the feet. In the summer-time, perhaps, the hinds are even redder in colour than the stag. There are, of course, albino red deer, as there are colourless examples of so many other beasts and birds. But in Ireland a somewhat persistent variety seems to have been naturally developed in the white-faced deer characteristic of Kerry. In these there is a white blaze between the horns, down the forehead, and ridge of the nose. The young of the red deer are profusely and distinctly spotted with white, the distribution of the spots being very like that which prevails in the axis deer. The neck in the young is slightly maned down the throat, and is without spots.

The colour of the red deer's horns varies a good deal in individuals and according to season. Generally in July and August, when the "velvet" has just been stripped off, the horns are a whitish-yellow, with a dark brown colour in the crevices; but as they grow older they tend to become dark umber-brown, with light tips to the prongs, these tips of bone becoming almost white in some instances. The "velvet," or thin skin covered with woolly hair, which clothes the young antlers, is a grayish-brown in colour. The horns are generally shed in February and March, and begin to grow again in April. They are complete in growth in July, and in August the "velvet" begins to peel off. The horns are scarcely free from these very unsightly strips of dead skin till the end of August or the beginning of September. In the author's painting of "Red Deer on the Heather" (month of August) he has shown the antlers still hung with these strips of whitish skin.

The neck of the red deer is long, often markedly so in the hind. Red deer are particularly broad across the forehead from eye to eye, and, seen from the front, the heavy wrinkled brows of the broad forehead so much overhang the eye that but little of that organ is visible. This, the observer will note, is very different from the appearance of the roebuck and of other primitive forms of deer, in which the eyes are more pig-like in position and somewhat nearer together. The shape of the red deer's head is not quite of the ideal beauty always represented by Landseer, who gives it a straight, or concave, nose profile—not too long—with dilated nostrils and enormous eyes. The hind sometimes has quite an ugly head, with a long nose, and rather a dog-like muzzle. The "pretty" type of Landseer hind might be explained by the theory that he had only drawn young hinds; but in the young hind the nostrils would not be so large and prominent as in Landseer's deer. In the young hind the muzzle is more pointed, and the nose is shorter than in the older animal. The stag may even exhibit quite a Roman, or arched, nose, but as a general rule he has a more beautifully shaped head than his mate. The ears are rather long, and are pointed

rather than round, round ears being characteristic of the lower and more pig-like types of deer.

Stags, and sometimes hinds, have small tusks or canine teeth in the upper jaw, as well as, of course, the invariable incisor-like canine in the lower jaw. Stags, but especially hinds, are not disinclined to use their teeth for purposes of offence, and hinds can give a very severe bite with their lower front teeth. The hoofs of the front toes are long and well developed, as are also the "false" hoofs of the side toes. As already mentioned, red deer fight with their feet (especially the front feet) almost as much as with their horns. They possess the usual metatarsal gland and tuft on the outer side of the hind legs, and the face gland, or tear pit, which characterises so many of the deer and some of the antelopes.



GLAND TUFT ON HIND LEG OF RED DEER

The antlers of the red deer rise somewhat slantingly and divergently from their bases on top of the skull, above and a little behind the orbits of the eyes. The pedicle of bone from which they grow is quite short, not more than from 1 in. to 2 in. in length, though of considerable diameter. As in most of the highly specialised deer, this pedicle tends to become shorter and shorter, though, as we have already seen in our review of horns and antlers, the pedicle was at one time *the* "horn," and remains such in the Bovine ruminants, among which it has grown to tremendous lengths, adding to itself an outer covering of horn. The great burr, or folding of bone, which marks the place outwardly where the antler joins the pedicle, is called the "coronet." Just above the coronet on the under side of the antler starts the

brow tine, which, after extending horizontally for a little distance over the forehead, turns up more or less abruptly. Above and close to the brow tine is the bez, or second tine, and after a longer interval of unbroken beam the great third, or trez[1] tine, bifurcates. No one of these three tines—frontal, bez, or trez—ever bifurcates at the tip[2] in the normal antler. The beam

STAG IN EARLY MARCH WITHOUT ANTLERS: TO SHOW PEDICLE OF ANTLERS.

above the bifurcation with the trez tine in highly-developed antlers broadens and increases greatly in girth. It then divides into a varying number of prongs, in the centre of which is what is called the "cup," sometimes actually a hollow which could

[1] The bez and trez (pronounced "bay" and "tray," and meaning twice and thrice) are terms derived from Norman-French, and their use in England dates from the Norman Conquest.

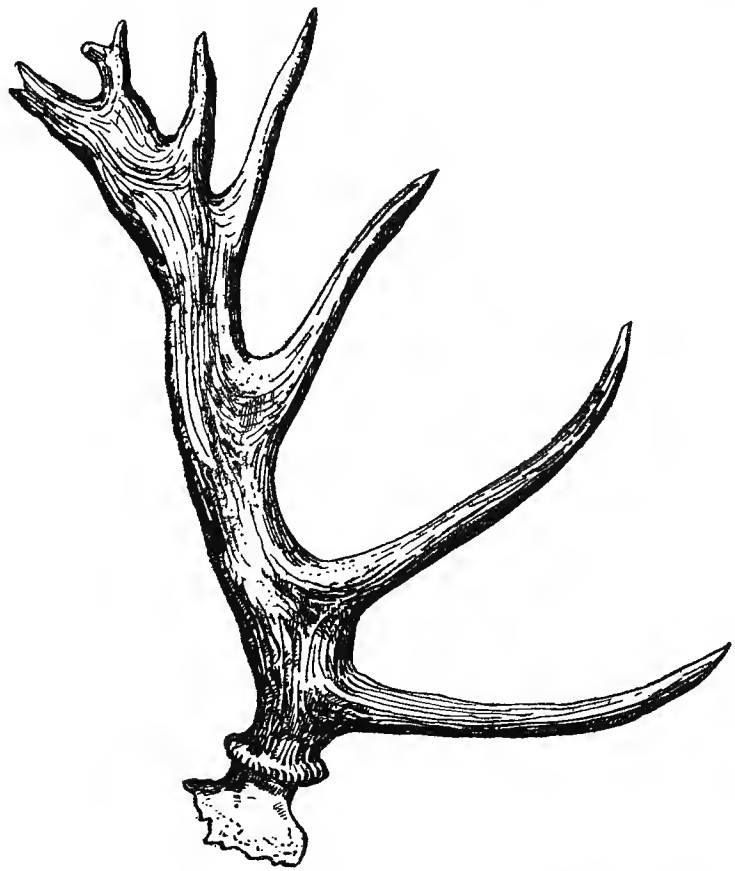
[2] Occasional, but rare, instances in recent park stags show a slight bifurcation at the tip of the frontal and trez tines.

contain liquid. The longest of these prongs starting from the cup is often turned more or less sharply downwards, and this and other prongs starting from the cup may bifurcate. It is in this development of the cup that the red deer differ from the other members of the same group, and, indeed, from all other deer. In the simplest form of development this cup is merely the original bifurcation of tines, one or other of the terminal prongs of which may again bifurcate. But in modern German and English park stags, and, above all, in the horns of stags of Great Britain and Ireland in Prehistoric or early historic times, the development of the cup reaches such an extravagance that it may give rise to as many as eleven points, possibly more. Early British stags often exhibited a great tendency to flattening out or palmation (accompanied by shortness of beam) in their antlers. The deer in Sussex parks seem to have a marked tendency towards palmation.

Stags' horns vary a good deal in their angle of divergence from the median line of the skull and neck. Of course, the most primitive type of antlers, in common with the horns of other primitive ruminants, would grow more or less parallel with the line of the neck. But as soon as specialisation begins in the deer, as well as in oxen, so much divergence may take place that, as in the case of the elk or bull or musk ox, the horns may grow out at right angles to the median line of the skull and neck. In the case of the red deer the divergence is hardly such as to constitute a right angle, but there is a good deal of variation in this respect, as necessarily in the measure of the span between the extremities of the horns. The span of the widest antlers found in Britain is approximately 5 ft. It is the measurement (allowing for restoration) of a most remarkable head found in Derbyshire (Prehistoric), and now in the Natural History Museum, London.[1] The

[1] This, which is one of the most remarkable stags' heads found in Britain, was lying about unrecognised in the huge unsorted collection of horns in the basement below the Natural History Museum, and its unearthing and exhibition are due to the efforts of Sir Edmund Loder and Mr. J. G. Millais.

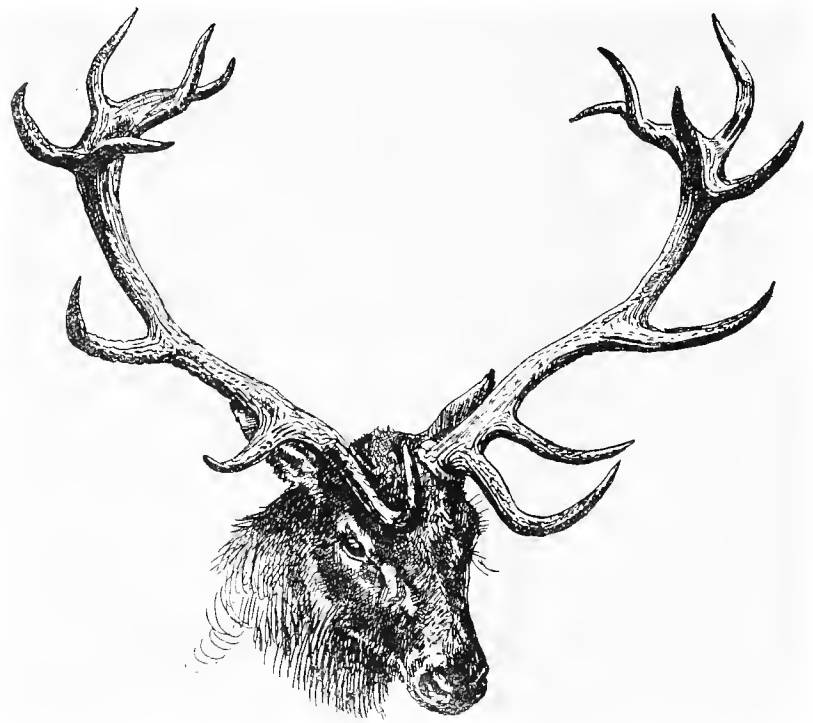
average span or measurement between the extremities of the antlers in an ordinarily good head is about 40 in., and the length, measured along the inner side of the beam, from the coronet to the extremity of the last prong of good English



RED DEER'S ANTLER OF PLEISTOCENE PERIOD: DUG UP AT DURHAM (BRITISH MUSEUM).

or Scotch heads may be as much as 36 in., though at the present day it is rare to obtain antlers as long as this. In Prehistoric times stags' antlers in Ireland and England often reached 42 in. in length, and this measurement is occasionally obtained, or even slightly exceeded, by half-wild stags in Ireland at the

present day. The extreme British measurement (which is perhaps 42½ in.) of the length of red deer's antlers is exceeded sometimes in Germany and Austria. The greatest length of any known German head is 47½ in. Mr. Millais is of opinion, in his classic work on *British Deer and their Horns*, that there has been a gradual degeneration in antlers amongst British deer. At



EXAMPLE OF WELL-DEVELOPED ANTLERS IN STAG OF 12 OR 13 YEARS OLD.

the present day those which are reputed to be first-class heads seldom measure more than 34 in. in length. Another point in which British stags evince degeneration is the increasing tendency, especially amongst those that are allowed to breed in and in, to slenderness of antler, in contradistinction to thickness and palmation. Many of the modern antlers are slim and quite rounded in beam, and the tines are short, and often tend to

disappear, the first which goes being the bez tine, while the cup is often represented by a simple bifurcation of the terminal point beyond the trez. There is little doubt that but for the intervention of man and the introduction of stags from Germany, the British deer, if it had not become extinct, would have degenerated to quite a small stag, with relatively simple antlers.

Occasionally it happens that a stag is polled—that is to say, grows no antlers at all, merely retaining the bony pedicles. Yet, so far from this being due to want of virility or vigour, these stags are generally heavier in build and much stronger than their horned brethren, with whom they contend so successfully for the possession of the hinds, that the polled stag is often the best breeder.

After the growth of a stag's antlers is complete, and the velvet is all removed (which means that the blood-vessels permeating the outer skin have dried up), the bone which remains is looked upon by many as dead matter, especially towards the end of the time in which it is borne by the stag's head; but Mr. Millais points out that the antlers of the stag, and of other deer as well, are permeated in the cells of the bone with an oily substance, seemingly composed of mucus and fat. But a certain amount of blood would still seem to ascend through the pores of the bone from the pedicle even after the velvet is stripped off the outside, and no doubt the antler still continues to "live," in an ever-lessening degree, until the time has come for it to fall off, this falling off being brought about by the absolute death of the bone above the pedicle. Naturally, whilst the stag's antlers are still covered with the velvet, this skin is not only permeated with blood-vessels, but with nerves, and the horns are extremely sensitive to injury. The older stags retain the velvet much longer than the young ones, whose horns take a much shorter time to grow, and Mr. Millais has pointed out how young stags whose horns are hard, and no longer sensitive, will for a few weeks enjoy the extreme pleasure of bullying their elders and superiors, whose softer antlers are much too sensitive to deal a return blow.

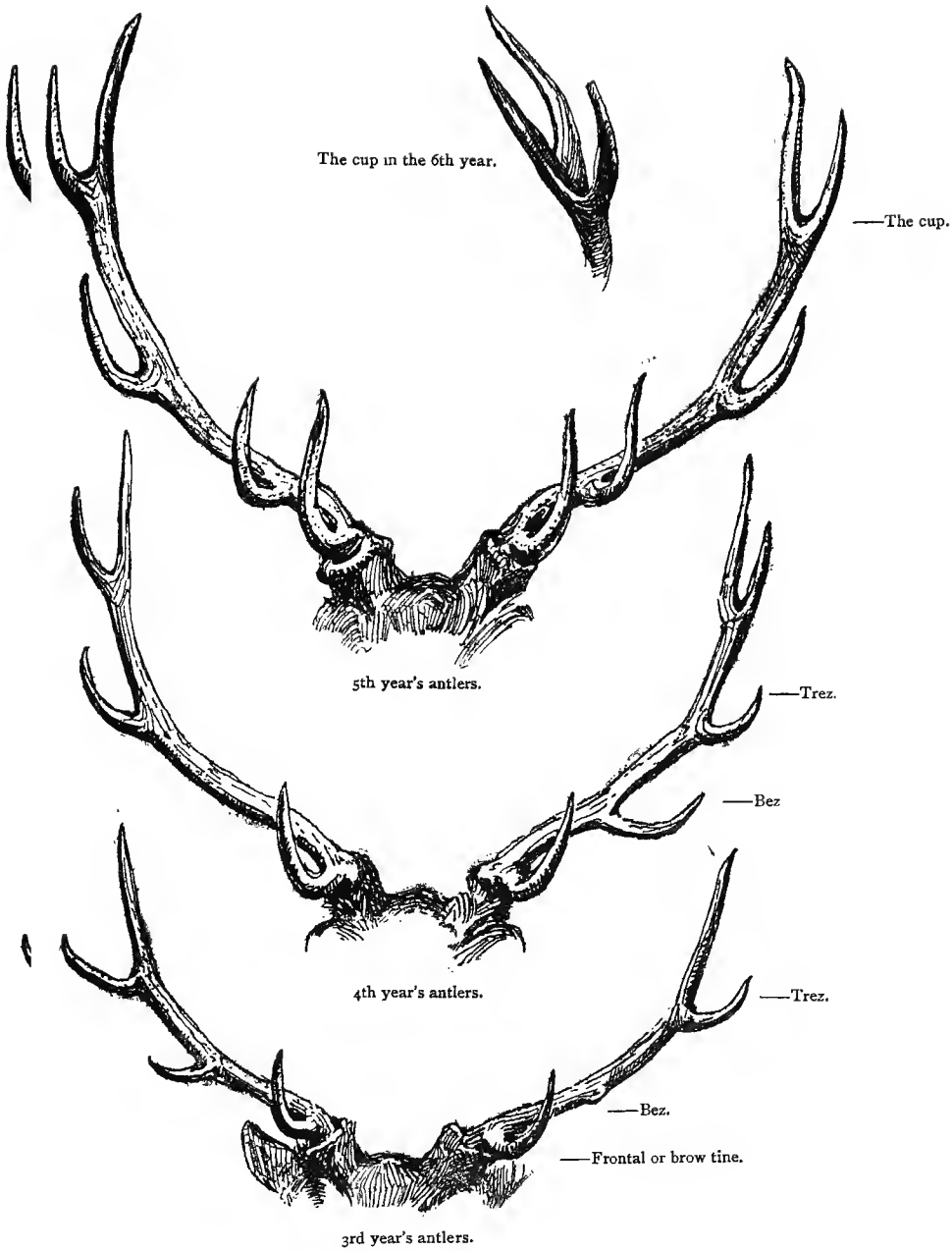
When stags fight with their antlers, or attack other animals, including man, they deal the fatal blow with the brow tine, stabbing downwards or upwards, whichever may be the easier method of dealing a blow home to the adversary's heart or belly. They can, no doubt, deal terrible blows, especially to any smaller animal, such as a man or a dog, by bringing the whole mass of the antlers to bear on the object; and in fighting with one another they sometimes strive to push the adversary over on his side with a direct thrust of the whole antler, or else by means of fencing to use the adversary's horns as a lever to turn over head and body. In other species of deer, in which the brow tine is not much developed, and its place for stabbing

2nd year's antlers.

THE PROGRESSIVE GROWTH OF A RED DEER'S ANTLERS.

1st year hornless.

purposes is not taken by any other forward prong or snag, the horns do not seem to be of so much use to the male for fighting with his rivals as might be imagined. In many species their development is due to an undefined impulse which stirs throughout living forms, and which cannot be adequately explained by Darwin's theory of female approval and selection, since that, for instance, would hardly explain the extraordinary beauty developed by certain sea-shells. Just as a race or an individual, when it has attained competence, and more than competence, begins to crave for beauty in some form, so it would seem that directly a species of plants or animals has become well established and successful it expends some of its accumulated energy in developing mere (useless ?) beauty.



THE PROGRESSIVE GROWTH OF A RED DEER'S ANTLERS.

As regards defence against attack, some of the heavy-bodied polled or "humble" stags (as already related) seem to be more successful in the struggle for the possession of the hinds than even those which have developed magnificent antlers. The polled stags can butt with their pedicles and bony foreheads most effectively. They do not waste time by fencing with their horns, as do those gifted with antlers, and, having no horns themselves, they offer no leverage by which, through a cunning wrench, they could, in wrestling, be thrown to the ground. Therefore, inasmuch as the rival stag provided with antlers could probably only stab to kill if he were able to throw his hornless enemy, he is unable to do much harm, and whilst he is considering his plan of campaign he is pushed and butted off the ground by the heavy, hornless male. It is undoubtedly the strongest and most vigorous stags, but not necessarily the largest antlered, that secure the most considerable harem.

The antlers of the red deer (as of other Cervines) illustrate to some extent in their gradual increase of growth the progress of evolution in the deer tribe generally. A male fawn born, say, in May, begins to grow an antler the following spring. This is a simple prong from 6 in. to 1 ft. long, sometimes ending in a slight knob. When the stag is only two years old its second growth of antler, which is merely slightly curved, and is more erect than in the fully developed animal, has a small brow tine and a trez (not always present in both antlers — represented, perhaps, in the left-hand antler by a mere knob), and beyond the trez the beam extends for some distance farther, and ends in a simple bifurcation. In the third year's antler the bez tine makes its appearance, perhaps only on one side, the whole antler increasing, of course, in length. In the fifth year of the creature's life each antler has a frontal, a bez, and a trez tine. In the sixth year the terminal bifurcation begins to form a cup, with three points on one side. In the seventh year there will be probably three points to each cup. After this, if the stag is a good one and of a good breed, the points in and about the terminal portion, or cup, go on increasing in numbers and

EXAMPLES OF THE DEVELOPMENT OF THE "CUP" OR TERMINAL FORK OF THE RED DEER'S ANTLERS.

I. Simple fork.
II. "Royal"—three prongs.
III. Development of "cup" in modern British stags.
IV. Example of exceptional palmation.
V. "Cups" of the antlers of a Prehistoric specimen.

complexity. A stag which has at least three points to the cup is called a royal. After the stag has reached the age of about fourteen years the horns do not go on improving in size and complexity, but actually degenerate, losing length, girth, and even points.

It is an extraordinary but apparently a well-attested fact that the deer gnaw their cast-off antlers, getting the tines between the molar teeth of their jaws, and moving these with that rotatory motion which may be observed in these and other ruminants when they are chewing. They also gnaw at the beam of their antlers with their chisel-like incisors of the lower jaw. It is undoubtedly the case that in this way some portion of the thrown-off bone is absorbed into the system, but this is a point of such importance as to demand very careful investigation, since it would seem well-nigh incredible that the whole of so hard and bony a mass could be completely devoured by anything but a hyæna. It would be interesting to know in this connection how captive deer manage in zoological gardens. Their horns are in some cases (such as the wapiti deer) almost as large as in deer living in a wild state, yet apparently no keeper has ever recorded the fact of any of these deer masticating and consuming the whole of the cast-off antler.

The red deer has a voice and uses it to some effect. Males and females utter a low, bleating sound to their friends, human and cervine—a sound which is almost a squeak. When alarmed, both males and females bark. When the breeding season approaches, however, the stag begins to express his yearning for the female by the bellow of the rut, a summons which attracts the female and also the rival. The "weird, wild, yawning roar" of the love-sick or jealous stag is described by Mr. Millais as being in his opinion one of the grandest sounds in nature, but he very rightly points out that it does not compare for effect with the roar of a lion. He made interesting experiments in this direction, and found that, whereas he could hear the roar of a lion under favourable conditions of wind at a distance of six miles, two miles was about the outside

that a stag's voice would carry. Mr. Lydekker compares the cry of the male red deer to the grunting, soughing roar of a leopard, a not inapt comparison, as the present writer, who has heard both, can testify.[1]

The breeding season of the red deer begins in September, though the males display much interest in the gathering together of a harem as early as August. In Scotland the breeding season is at its height at the beginning of October. Some vigorous stags will attempt to serve a harem of sixty hinds. During this month of love-making they shepherd their hinds incessantly, striving to keep them together and to beat off the intrusions of rivals. At this period the stag has but little leisure to devote to eating, being constantly on the alert. Despite his utmost efforts sometimes his preserves are poached on by daring youngsters, two- or three-year-olds.

Gestation lasts a little over eight months, and the fawns are born, therefore, in May and June. The mother attends and defends her fawn with the greatest care and bravery. She teaches it to conceal itself instantly on the approach of danger, the signal being generally a tap with the fore foot. Red deer very rarely bring forth more than one young at a birth, and although twins are not unknown, triplets are absolutely unheard of. During the winter, the hind, though pregnant with another young one, assiduously cares for her half-grown fawn, and at that season hinds and fawns congregate together while the males resume

[1] I was much struck by the loud bellow uttered by the Barbary stag when travelling through the forests of the Tunisian-Algerian borderland, in the late autumn of 1897, where these animals, now protected by the French, are abundant. By a curious coincidence, in the same forest we heard a leopard calling. The two *spahis*, who were sent with me as escort by the French Government and the French verderer of an adjoining lodge, both thought it was a stag calling, but on their making for the sound they put up a leopard. In the same kind of country, but a little farther north, in 1880 I took part in some battues got up by the French and Tunisians, in which we killed Barbary stags, leopards, and lions. The lion is now extinct in that country, but in 1880 he still lived partly on the unprotected Barbary deer, which have increased somewhat in number since the lion was exterminated.—H. H. J.

their bachelor condition. Male stags seldom fight seriously out of the brief period of the rutting season, and during winter and spring great friendships sometimes arise between an old male and a young one, the young one often acting as sentry or as pioneer. In great migrations to new feeding-grounds, hinds, fawns, and stags mix together, and a hind generally leads the way. In June, after the fawns are born, stags often seek out a particular hind, perhaps a wife of the year before, and consort with her. The extreme limit of age for a male red deer seems to be thirty years, and for a hind twenty-one or twenty-two. Both sexes, however, shows signs of age after fourteen years. Their dentition is not complete till they are five years old, and it is not until that age that stags completely develop their upper canine tusks.

Red deer are good swimmers and readily take to the water, but it is doubtful whether they would possess the necessary strength to swim a strait of more than ten miles broad. They make nothing, of course, of crossing rivers and small lakes or narrow arms of the sea. When swimming they keep the whole of the body under water. The neck is outstretched, and the horns (in the case of the male) are thrown well back. Mr. Millais considers that when the deer reach shallow water, cease, in fact, to be out of their depth, they raise the head and neck considerably above the water.

Their senses of sight, hearing, and smell are all keen, but they are not all as intelligent in discriminating dangerous from harmless objects as the roebuck.

The food of the red deer consists of grass, leaves and leaf shoots, mushrooms and such fungi as would be wholesome to the human being, beech-nuts, and acorns. Deer will also eat heather, and they are particularly fond of that fine emerald-green grass that grows in the bare patches and on the edges of rills and watercourses in and out amongst the heather. They are said also to eat dry seaweed on the coasts of some of the Scotch islands. In captivity they can become strangely omnivorous, and even slightly carnivorous, not even objecting to

the meat in sandwiches, certainly not rejecting ham, this perhaps on account of its saltness. Of salt they are very fond, and will travel far in some districts in search of salt "licks." For this reason they visit the sea-coast (where they are undisturbed), and lick the brine off the rocks that have been swept by the tide. There are certain sages and grasses of the moorland kinds which they affect, no doubt for the same reason, because salt would be obtained from the potash of these grasses, as it is from similar forms in Africa, which are also much appreciated by antelopes.

On the whole, forests are necessary to the well-being of the red deer, and their advance in England and the rest of Europe must have depended on the retreat of the Glacial conditions and the revival of trees. Perhaps this arises from the fact that, when in an absolutely wild state, they would find little or no sustenance in the winter season except in the woodland, where they would have a certain amount of evergreen foliage, bark, twigs, dry leaves, seeds, and fruit to fall back on. In summer-time they generally feed at night, in the morning, and in the late afternoon, resting a good deal in shelter during the heat of the day. In winter they feed at intervals all day and all night; spend their time, in fact, hunting for food, unless artificially fed in parks.

They are not known to suffer from many diseases, but every now and then an epidemic of some kind, akin, no doubt, to diseases affecting cattle and sheep, may sweep through the herds, decimating, or even exterminating them, unless human intervention checks the spread of the malady. It is known that they are liable to hydrophobia. When this disease has been introduced amongst them by a stag or a hind having been bitten by a rabid dog, it is spread among the deer themselves by those far gone in hydrophobia taking to nibbling at the skin of the healthy deer, which they do until there is a slight abrasion, as though impelled by some perverted instinct to spread the disease. No recent cases have been reported of hydrophobia amongst deer, and this, no doubt, is due to the complete extermination of the disease amongst all animals since greater care was taken by the

authorities to stamp it out among dogs. A bot-fly, called *Cephenomyia rufibarbis*, attaches itself very specially to the red deer. In outward appearance it mimics a bee, but of course has only one pair of wings. This fly is found in Great Britain, Germany, and wherever the red deer has its habitat. The flies generally begin their attacks in May. These odious insects (an adjective which can almost without discrimination be applied to all insects) enter the open nostrils of the deer and squirt out from their vent a drop of fluid containing a number of very small, just-hatched maggots. These fasten themselves by hooks to the tender skin inside the nostrils, and then by degrees gradually wriggle themselves up the passage of the nose till they reach the back of the throat. Their presence and the strong irritation they provoke induce a great flow of mucus. On this mucus they feed, and increase in size till they are over an inch in length. Apparently the deer is generally able to eject these grubs by coughing and sneezing, and only suffers temporary inconvenience by giving them this unwilling hospitality. When they are coughed out they fall to the ground and become chrysalides for two or three days, after which the perfect insect emerges. Much more serious results, however, come from the attacks of a fly which is akin to the ox-warble.

Red deer may be considered to have reached their maximum development in size and numbers in Great Britain and Ireland about the time when Julius Cæsar invaded Britain. The complete close of the Glacial ages a few thousand years before had caused Great Britain to become a land of dense forests (only broken by a few mountain tops, moors, chalk downs, and human clearings) from the south of England northwards to Sutherlandshire. Ireland, also, was much forested, especially in the south-west and east. The megaceros had died out long before ; only a few fallow deer lingered possibly in England. The roe deer in Great Britain was no serious rival, the reindeer was extinct in Ireland, and was being rapidly driven by the red deer into the treeless desolation of the extreme north of Scotland and the Orkney Islands. The assiduity of the Romans in England, no

doubt, had something to do with the diminution of the red deer, and the gradual civilisation and increase of population in the two islands increased the want of arable and pasture lands and diminished the forest. When the Normans came, although the deer were saved from destruction at the hands of the common people, and were in a measure preserved, still the hunting of the nobles and of the outlaws put a limit to their increase. As century after century went by and forest after forest was laid low, the deer began to be grievously affected from restricted feeding-grounds and interbreeding. That they suffer from this (unless new blood is constantly introduced) in each great park is obvious, and in several Government forests they have become extinct from this cause within the memory of men now living.

All things considered, we may congratulate ourselves on the splendid home—I hope a permanent home—that the red deer has found in Scotland. The glorious mountain scenery, the scattered pine and fir forests, the innumerable tumbling streams, broad rivers, and lovely lakes—studded with islands to which the deer swim off for concealment and repose ; the wonderful scenic effects of the mists alternating with sunshine, the snow that covers the ground during the winter and dapples the mountains in spring and autumn, the glorious flush of the purple heather in the late summer, the lichen-painted rocks interspersed with the greenest moss and gay in August with yellow ragwort : this is a setting worthy of what we may regard—even reviewing the splendid past of Megaceros and Alces—as a very noble representative of the Deer tribe.

CHAPTER XIV

UNGULATA (continued).

ARTIODACTYLA: THE BOVINES

FAMILY: *BOVIDÆ.* THE HOLLOW-HORNED RUMINANTS

IT will hardly be necessary to describe the main features of this family, since they have been already given in a general review of the Pecora. They are divided at the present day into six sub-families: the Tragelaphs, or Spiral-horned Bovids; the Antelopes, or Ring-horned Bovids; the Capricorns, or Mountain Antelopes; the Ovi-bovines (represented at the present day only by the Musk Ox); the True Oxen; and the Sheep and Goats. All the members of this family are very closely inter-related, and their classification is a matter of some difficulty. Nearly each group has in equal measure preserved primitive features in some directions, and has attained great specialisation in others. On the whole, it may be said that the antelopes proper (those with annulated horns), the sheep and goats, and capricorns (which also share this feature of the annulated growth of the horn) are specially related each to the other. The Tragelaphs in some ways are the most primitive of the sub-families, and their nearest relations are with the oxen. The oxen stand somewhat apart, and the musk ox has some affinities with the Bovine group; but, on the other hand, is perhaps most nearly related to the Capricorns.

So far as we know, the Tragelaphine sub-family (elands, kudus, bushbucks) never extended its range to England, though

representatives of this group may have reached Southern France. The Tragelaphs possibly originated in Asia, where they have left one living example in the nilghai. They attained considerable development in Greece, Asia Minor, and Algeria, but their range at the present day is entirely confined to India and Tropical Africa. The True Antelopes are represented in the British fauna of the Pleistocene by two examples, a gazelle (*Gazella anglica*), the remains of which have been found in the eastern counties; and the saiga (*Saiga tartarica*), a somewhat aberrant antelope belonging to the Gazelle group.

But little is known regarding *Gazella anglica*, which was probably allied in race to one or other of those types of rather sturdily-built gazelles with lyrate horns, which are found at the present day in the temperate regions of Central Asia. The gazelle (together with the saiga and other forms that co-existed with them in Eastern Britain in the early Pleistocene) is rather associated with a dry country of steppes. At the time when it lived in England there are indications that East Anglia was more connected with Belgium, Holland, and Germany (of which it formed a projection) than with the rest of Britain, owing to the inlet of the North Sea, which began at the Wash. There is much in the present condition of the plains of Northern Germany which would thoroughly suit gazelles (no change of climate being necessary), and it only needs to give East Anglia the continental climate of Prussia to make it suitable for habitation by these steppe-frequenting antelopes. There would be gazelles allied to the Persian and Tibetan now in Northern Germany but for the presence of man.

As regards the saiga, this strange-looking beast inhabited Eastern and Southern England much more decidedly than did the gazelle. Its remains have been found (amongst other places) at Twickenham, in the Thames Valley. Its existence in England was seemingly of later occurrence by perhaps thousands of years than that of the gazelle in East Anglia, which apparently died out at the beginning of the Glacial age.

Saiga tatarica. THE SAIGA, OR SWOLLEN-NOSED GAZELLE

This antelope, though grouped with the gazelles, which it resembles in its horns, is yet a very peculiar creature of puzzling affinities. The females are hornless; but in males and females there are short nasal bones and a high, bloated nose, terminating in a snout that is almost pig-like. The ears are so strangely truncated as to look as though they had been cropped. The general appearance of the body is not unlike that of a sheep. The hoofs are somewhat heavy and broad. False hoofs are present, and the feet are rather sheep-like. The tail is short. The coloration is yellowish-gray, with a whitish throat and chest, and a touch of white on the edge of the rump. The fact that this antelope has only two premolar teeth in the lower jaw instead of the three which are almost universal among ruminants, shows specialisation. This loss of premolars, however, also occurs in another aberrant gazelline, the springbok of South Africa. But a fossil saiga has been discovered in Moravia and Germany which had the full number of three premolars. The British specimens are too imperfect to decide as yet to which type—the ancient or the modern—the British Saiga belonged. On the other hand, the existing saiga retains the more primitive feature of four teats, while all the other known gazelles are only provided with two mammæ.

The nearest living relation of the saiga is the interesting chiru antelope of Tibet. In this the horns are very long, and the form of the animal is more graceful than in the saiga, while it retains the full number of premolar teeth in both jaws, yet, on the other hand, has only two teats. The sides of the muzzle and nose in the male are much swollen, suggesting an approximation to the saiga in their external nasal protuberance. The outward resemblance of the saiga to a sheep is, no doubt, simply a case of parallelism, and it must be regarded as an aberrant gazelle which has retained a more primitive number of mammæ. It is at present so characteristic of the treeless steppes of Eastern Europe and Central Asia that its presence in England is somewhat

Photo by the Duchess of Bedford.

THE SAIGA (*Saiga tatarica*).

From a living specimen at Woburn Park.

Photo by the Duchess of Bedford.

THE MUSK OX (*Ovibos moschatus*).

From the specimen (a male) until lately living at Woburn Park.

To face p. 342.

inconsistent with the supposed forested nature of that country. It may, however, have only existed here for a short time in one of the inter-Glacial periods before the smitten forests had recovered their luxuriance.

Ovibos moschatus. The Musk Ox

The Musk Ox is another of the puzzles which await solution in the classification of the Ruminants. In size it is that of a small ox, and is very ox-like in build and in the shape of the head, especially in the broad forehead, short nose, and large muzzle. The muzzle, however, is hairy, and not a wet, naked muffle, as in the oxen. The short ears are rather more sheep-like in appearance, not being the characteristic broad ears of the ox. The tail is so short as to be almost non-existent. This is not an ox-like characteristic. The hoofs and the false hoofs are somewhat bovine in appearance. The outer hoof in each foot is broader and more rounded than the inner one, which is pointed. This peculiarity is derived from the characteristic habits of the animal. It is as though it always turned its toes in. Unlike the oxen, it has an ante-orbital pit, or tear gland, similar to that which is present in so many antelopes, deer, and sheep—a feature which has disappeared in the oxen. The molar teeth, though long-crowned, lack the additional column which is characteristic of those teeth in the oxen. The cannon bones—that is to say, the fused metacarpal and metatarsal bones, which are equivalent to the bones of our knuckles and instep—are short and stout as in the oxen, and not long and slender as in most of the sheep and antelopes. On the other hand, these cannon bones in the musk ox are absolutely single, with no trace whatever of that division down the middle which makes the same bones in the oxen look like (what they really are) two separate bones joined in the middle. Another point in which the musk oxen differ entirely from the Bovines is that they retain on the *outer* side of each front leg a large splint bone (a metacarpal), which, beginning at the wrist joint, reaches nearly as far down as the knuckle, or metacarpal joint. On the inner side of each front leg

there is no trace of the metacarpal bone of the second toe. The oxen have this outer metacarpal splint of the musk ox merely represented by a small knob of bone. In this point, therefore, *Ovibos* is more primitive than the oxen.[1]

In the anatomy of its soft parts the musk ox is somewhat isolated, but perhaps conforms most nearly to the capricorns. In the direction of this group, indeed, its nearest affinities seem to lie. It branched off, no doubt, from a primitive type of hollow-horned ruminant, which was the stock which gave rise to the oxen on the one hand and the capricorns on the other, while the capricorns are the parent forms of the sheep and goats. These mountain antelopes, as they are usually termed, are represented at the present day by *Budorcas*, a heavily built animal living in Tibet, with a strong superficial resemblance to the musk ox; by the serows of the Chinese, Indian, Sumatran, and Japanese mountains[2]; by the chamois of the Alps and the Caucasus; and, lastly, by another strange-looking creature, the rocky mountain goat (*Haploceros*) of North-west America.

The horns of the musk ox are, perhaps, its most peculiar feature. Those of the male are enormously expanded and flattened at the base, and the bases almost touch in the middle of the forehead. They are curved abruptly downwards and then upwards, and resemble very strongly those of the white-tailed

[1] See illustration on p. 281. The vestiges of the second and fifth metacarpal and metatarsal bones in the skeletons of the *Bovidæ* have been very insufficiently illustrated and considered by zoologists. Metatarsal vestiges are very rare—perhaps only to be met with in some Tragelaphs and Cephalophines. All the Bovids are "plesiometacarpalian," like the True Deer. It is only the upper portions of the side metacarpals which survive, though there are also nodules of bone (in the sheep, for example) which support the side hoofs. In the *Tragelaphinæ* (elands, kudus, bongos, bushbucks) the side metacarpals are well developed, and metatarsals also. They are present in the Cephalophines, but absent from most other antelopes. Their traces in sheep and goats are fleeting. In the oxen, the musk ox, and the capricorns they are only developed on one side—the outer.

[2] *Urotragus caudatus*, the long-tailed goral of North China, is a remarkable form, retaining the primitive long tail which has disappeared in so many bovids.

gnu, the resemblance, of course, being purely accidental. The flattened base of the horns and a good deal of their length is in adult males marked by coarse, broken grooves or fissures running parallel with the length of the horn. In some specimens of younger animals or females these longitudinal fissures are less marked, and are crossed at right angles by "ripplings," which may be the traces of original annulations similar to those which characterise the horns of antelopes, sheep, and capricorns. Much of the extravagant boss represented in the frontal portion of the male's horn is but a development of the outer horny sheath, and is only represented by a very roughened surface of bone, from which the horn core grows out sideways. In the female the horny coverings of these bosses do not meet in the centre, but there is a considerable space between the horn bosses covered with hair. In the young animal (and this is a characteristic of the horns of fossil American species) the shape and direction of the horns are not so aberrant. The bony core grows out laterally and horizontally from the frontal bone, as it does in the common ox, and the horny sheath continues this horizontal direction, and then turns sharply upward exactly like the horns of a domestic cow. There is at this stage (and the same remark applies to at least one species of fossil musk ox) no downward sweep of the horn. We are still, however, very far from the type of horn found in the capricorns (excepting *Budorcas*), for in these the bony cores and their horny coverings rise more or less vertically from the frontal bone, and are directed backwards. This is the same with sheep and goats, except that in the former, after an upward and backward direction, the horns curve round in most cases to the front. In the North African wild sheep, however, there is some approximation made to the outward and downward curve of the musk ox's horns.

The female musk ox has a somewhat primitive udder. There are four functional teats, and an extra, or fifth mamma, which is not functional. This feature of five teats is repeated (not functionally, of course) in the male. In the True Oxen, besides the four functional teats of the udder, there are (as any one can

ascertain who examines the domestic cow) very often two more mammæ placed on the front of the udder, from which, of course, no milk can be drawn.

From the little that we know of its past history in fossil forms, and arguing from the present locality of its only near relations—the Central Asian capricorns and the primitive oxen—we may suppose that the musk ox originated in the chief womb of the world, somewhere in Asia, possibly in the regions north of India. From Central Asia it spread across Behring Straits into Arctic America, where it still exists. During the Pleistocene, however, it travelled across Siberia and Central Europe into France and the Pyrenees. It also entered England from the direction of Belgium (no doubt at a time when the land connection subsisted), and spread right across Southern England and into East Anglia. Its remains have been obtained from Kent, from various places in the valley of the Thames, from near Bath, and from Gloucestershire, as well as from Norfolk. Elsewhere in the Old World its remains have been found in Northern Siberia, of such a recent character as to suggest that its extinction in that part of the world has been within the Historical Epoch. Its remains in Germany, as in England, date from the Pleistocene period and before the advent of the Glacial ages. This is an important point to remember, because the presence of the musk ox in this island, in company with the remains of such creatures as the lion, hyæna, reindeer, and hippopotamus, was thought to present an inexplicable jumble of northern and southern forms, of some creatures which *must* have a warm climate and of others absolutely dependent for their very existence on Arctic conditions. On second thoughts, however, it will be seen that, judging from their affinities, both musk ox and reindeer must have originated in a region possessing a temperate climate ; at any rate, a country with hot summers, a region equally well admitting the existence in the summer-time or all the year round of lions and hippopotamuses. The struggle for existence drove the musk ox farther and farther north, until it has only survived finally in the extreme Arctic regions of North America. During

all these ages, no doubt, it has slightly differentiated, and has gone on fitting itself more and more for life in a climate of rigorous cold. At the present day its range is limited to a small portion of North America eastwards of the Mackenzie River, and north of the 60th degree of latitude. From here it extends over a good deal of Greenland, especially along the east coast, from regions close to the Pole to almost the southern extremity of that huge continental island. The musk ox formerly, and not very long ago, existed in Alaska. The discovery of its remains in that extreme north-western part of America was an interesting point, as it showed that in all probability *Ovibos* reached North America from Asia rather than from Northern Europe ; and this probability is increased by the fact that no remains of it have ever been discovered in Spitzbergen or Franz-Josef Land. But the ancient distribution of the musk ox in North America extended much farther south than Alaska and Canada—almost, if not quite, to the Gulf of Mexico—an additional proof that the genus could adapt itself to a warm climate ; possibly, in fact, preferred a warm climate to a cold. In Temperate North America the musk ox was represented by perhaps two other species, one with a bulging forehead (called *Ovibos bombifrons*), and the other with a cavity or depression below the frontal bone (*Ovibos cavifrons*). But Mr. Lydekker, perhaps wisely, attempts to show that the cavifront specimen is due to injuries inflicted on the skull, and that *Ovibos bombifrons* is the only valid species of musk ox coming from Temperate America which differs from *O. moschatus*.

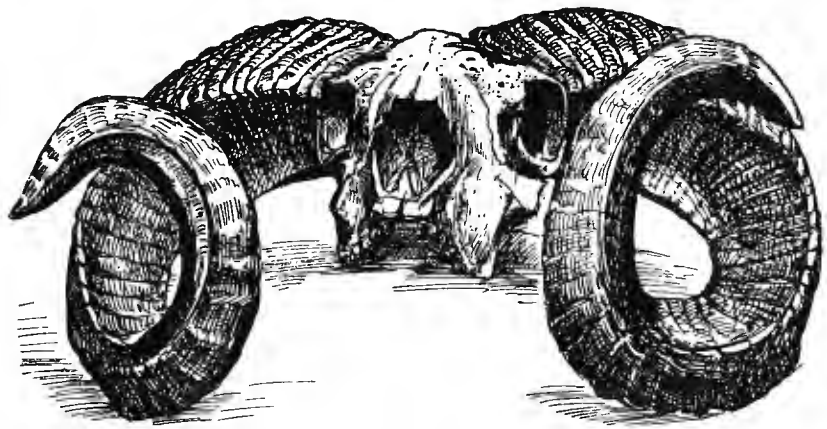
The illustration of the musk ox which, together with the saiga, faces p. 342 is of peculiar interest. It is a photograph by the Duchess of Bedford of the only living musk ox which has been in Britain since the early part of the Pleistocene period. At one time it was supposed that it would be impossible for a musk ox to live in this temperate climate, but the specimen referred to has now been for some years in the Duke of Bedford's collection at Woburn Abbey.

SUB-FAMILY: *CAPRINÆ*. THE SHEEP AND GOATS

The Sheep and Goats are evidently closely allied; indeed, it is said that they will interbreed and can produce hybrids. Their horns, especially in the female and young, show those annulations which are so characteristic of the True Antelopes, and which are found in a less marked type in the capricorns. From this last-named stock it is almost certain that the sheep and goats arose, the capricorns having somewhat more archaic features in the anatomy of their soft parts and their bones. Although the sheep have departed somewhat widely from the antelopes or capricorns in the development and directions of their horns, they present primitive features in some directions, and it is more probable that they originated simultaneously with and independently of the goats from capricorn ancestors—from some type very like the tahr of India and Arabia (*Hemitragus*). The tahrs date back in a fossil state to the Pliocene Epoch. Two of the existing forms retain the more primitive four teats in the female. The tahrs, however, in common with all the goats and all but two species of sheep, have very short tails. The length of the tail is a problem, both in the origin of the sheep in general and of the domestic sheep in particular. The domestic sheep (unless interfered with by man) has in all its varieties, woolly and hairy, a long tail, which is supported by a considerable number of caudal vertebræ. The same feature exists in another sheep, the audad (*Ovis lervia*) of North Africa, a form once found in France and Spain. It is impossible, however, to derive the domestic sheep from the audad for many good reasons. Curiously enough, the audad is rather capricorn-like in a number of points, and (in the author's opinion) offers marked affinities to the tahr. The fact of its retaining a long tail, therefore, seems to point to the disappearance of this feature in the tahrs as having been a matter of recent specialisation, and as though the original sheep had possessed this appendage, which has persisted in the least specialised form of sheep (the audad) and in one of the several wild species from which the domestic sheep was derived. One

capricorn, *Urotragus caudatus*, the goral of North China, has a very long tail.

The goats have lost almost all traces of the side toes, and are exclusively two-toed, though they still retain the false hoofs and nodules of bone of the missing digits. In the sheep, however, thin slips of metacarpal bones—the upper ends—are encountered in most of the species, though they are easily detached and lost sight of in the tendons and skin of the fore leg. The sheep also retain traces of the tear pit, or gland



HORNS OF A RAM (*Ovis aries*) FROM ACHILL ISLAND, OFF WEST COAST OF IRELAND.

on the face, which the goats seem to have lost, but which *Ovibos* and some of the capricorns[1] have retained. The sheep, also, have not developed the peculiar chin beard of the goats. They favour, on the contrary, the throat mane so characteristic of certain capricorns and of the tahr. This throat mane is seen prominently developed in the North African wild sheep, but it is by no means limited to that species, for it is frequently abundant in the Armenian sheep (which is very near to the domestic), the urial (*Ovis vignei*), and the European mouflon ; while in domestic sheep this throat fringe is represented abundantly in African forms, and elsewhere is even transformed into a dewlap of the skin.

[1] *Nemorhædus ;* the gland has been lost in *Hemitragus.*

A wild sheep once existed in England (*Ovis savini*), which is thought by Lydekker to have resembled the Armenian mouflon. No traces of this sheep, however, are found in this country of a later date than the early part of the Pleistocene Epoch, almost before Glacial conditions supervened. The only remains we have yet found come from East Anglia. It is very doubtful if it was contemporaneous with man in England, and almost certain that the domestic sheep of England in their most primitive types could not be descended from this form by its gradual taming. No traces of domestic animals existing in these islands (except the dog, perhaps) are obtainable till the *Neolithic period*, which would be after the close of the Glacial conditions. But *Ovis savini* may have existed, almost certainly did, on the Continent of Europe, and may have been one of the sources from which *Ovis aries*, the domestic sheep, was formed. At present it is an open question whether any wild sheep continued to exist in the British Islands through and after the Glacial ages. The Highland sheep and some of the Welsh breeds, and the sheep to be seen on the islands off the west coast of Ireland, are extremely like wild animals. Those from Western Ireland and from St. Kilda off the west coast of Scotland have a tendency to lose their wool and revert to a hairy type. On the other hand, Highland sheep in the formation of their horns are very like the merino breed from Central Spain. The Soa and St. Kilda sheep are known to have been introduced by the vikings from Norway and the Faröes.

The difficulty in the pedigree of the domestic sheep is its long tail, as already mentioned. It almost seems necessary to assume the existence of an extinct species (this might have been *Ovis savini*), which, like the North African *Ovis lervia*, retained the primitive long tail lost in all other living wild sheep. If physiologists could assure us that it was possible for an animal to replace the lost vertebræ of its tail by the fresh development of nodules of bone, and if we could assume that the domestic sheep had done this, it would be easy enough to decide that our sheep had arisen from a mingling of wild stock such as the

Photo by C. Reid.

HIGHLAND SHEEP (*Ovis aries*).

Photo by W. P. Dando, F.Z.S.

SOA SHEEP, ST. KILDA (*Ovis aries*).

Photo by W. P. Dando, F.Z.S.

FEMALE CORSICAN MOUFLON (*Ovis musimon*): TO SHOW TAIL.

To face p. 350.

European and Armenian mouflons, with perhaps a little intermixture of some type like *Ovis vignei* of Central Asia. The hairy domestic sheep of Syria and Africa resemble most, perhaps, the Armenian mouflon (except that they have long, and sometimes very fat, tails). The domestic sheep of Europe, England, and Northern Asia (barring the difference of tail) offer considerable resemblance in their horns to *Ovis vignei*, the urial, and it is noteworthy that this wild sheep has horns in the female. The European mouflon has hornless females. In the domestic sheep there is a curious difference in this particular. In the African and Syrian breeds, which are, I believe, derived from some form very like the Armenian mouflon, the females never have any horns. In the English, European, and North Asiatic sheep the females are horned, and in this important particular, as well as in the shape of the horns in the male, they offer affinities to *Ovis vignei*. Moreover, the tail in this wild sheep is a little less short than in the mouflon.

No fossil remains dating beyond the age of domestic animals exist from any part of the British Islands to show that there was an indigenous wild goat. The author believes he is right in saying that such bones of goats as there are, are always found in connection with human settlements, and are of the Neolithic period. Goats have run wild, however, and still exist in feral conditions in parts of Wales, the western islands of Scotland, and on islands off the west coast of Ireland. These Irish wild goats are, perhaps, only represented at the present day by small herds on the cliff-mountains of Achill Island. They are white in colour. Large as are the horns of Welsh and Irish goats, they do not, perhaps, reach the great development met with in the original wild goat, *Capra hircus ægagrus*, of Persia, Asia Minor, and Western India.

Sub-Family: *BOVINÆ*. THE OXEN

The Bovine sub-family of the *Bovidæ* is thought by palæontologists to have been of comparatively late origin, and to be the most specialised group of the Hollow-horned Ruminants.

I do not find myself quite in agreement with the authorities on these points. In the first place, from the little we know of the geological age of oxen, sheep, and goats, the oxen appear to be older than the last two named ; and though specialised in some directions, they retain in others distinctly primitive features. The cannon bones of front and hind legs (especially in the front) are decidedly short, and they are divided down the middle by so distinct and deep a groove as to be almost two distinct bones, instead of being completely fused into one, as is the case with the sheep and goats, the musk ox, and most antelopes. Even in the deer the original division in the cannon bone is only faintly indicated. The mammæ, also, instead of being only four, as in the deer, or two, as in so many sheep and antelopes, are practically six in number. Only four are functional teats, but on the udders of most cows there are two additional mammæ not normally functional. In this there would seem to be some slight approximation towards the condition of the swine (as examples of primitive Artiodactyles), in which there are six to ten mammæ. The tail in oxen is invariably long—also a primitive feature. In the most archaic of living oxen, the Anoa and Tamarau buffaloes, there are indications of the white spots, gorgets, and other markings of the primitive Artiodactyles; and though these are not developed anything like as much as in the Deer and Tragelaphs, yet in the Capricorns, Goats, Sheep, and Antelopes they have absolutely disappeared. The horns of oxen do not display any sign of regular annulation, which is characteristic of all the other groups of the *Bovidæ* except the Tragelaphs. Indeed, in the structure of their horns they offer, perhaps, slightly more approximation to the Tragelaphs than to any other of their relations. In the last named, especially in an archaic form like the nilghai, there is a tendency towards the development of triangular twisted horns, in which the angle facing the front is often developed into a strong ridge. This three-cornered, and perhaps slightly twisted, type of horn is characteristic of the earliest known or most primitive of living oxen (*Leptobos*, *Amphibos*,

Anoa). In these archaic types of oxen the horns diverge but slightly from the median line of the skull, present no boss in front between the horn cores, and lie backwards almost parallel with the ridge of the neck, and very nearly in the same line as the profile of the nose. In all the developments of oxen from this primitive type, however, the direction of the horns is greatly changed, and the tendency is for the horn cores to grow outwards almost at right angles to the median line of the skull, while the tips of the horns are either directed backwards or upwards and forwards. In the original types of *Bos taurus*, the domestic ox, the direction of the horns is almost the exact reverse of what it was in the primitive oxen.

So far as specialised features are concerned, the oxen have developed somewhat peculiar molar teeth in the upper jaw, with very long and square-shaped crowns, on the inner side of which there is a slender, cylindrical additional column.[1] There is never any trace of the upper canine teeth. Horns are present in both male and female of the existing forms. There are no face glands or tear pits. The young are scarcely ever marked with white spots, except such slight remains of these markings as may occur in the young and adult buffaloes of the Malay Archipelago. The stomach is, perhaps, more highly developed for rumination than in any of the other Pecorines. On the other hand, there is a gall-bladder persisting which has been lost by so many antelopes and by all True Deer.

For the origin of the oxen we must again go back to Asia, where, with the exception of the camels and rhinoceroses, most of the higher mammals have been evolved. India or thereabouts was the district in which the Bovine type first differentiated from a form of Hollow-horned Ruminant, allied on the one hand to

[1] The upper molar teeth of the nilghai (the nearest living ally to the oxen) are also long-crowned, and there is a large accessory column in those of the upper jaw. In the rest of the Tragelaphs the molars are short-crowned, but those in the upper jaw possess a small inner accessory column.

the early Tragelaphs and Cephalophines,[1] and on the other to the Capricorns. Not only did the sub-family *Bovinæ* originate in India, but in the northern parts of that country the genus *Bos*, and the Taurine sub-genus or original parent of the common ox, also had its birth.

The most archaic of living oxen are the buffaloes. From something like the buffalo stock arose a form classified as the sub-genus *Bibos*, which is represented by the huge gaur and gayal of India. From this Bibovine group separated on the one hand the yak and the bisons, and on the other hand the Taurine group represented in recent times by the aurochs and its descendants, the European domesticated cattle and *Bos indicus*, or the humped zebu type, from which the domestic cattle of Africa and India are descended. The first True Bison was also evolved in Northern India, a kindred form giving rise to the yak. The bison spread northwards in the Pliocene or penultimate period of the Tertiary Epoch. From Central Asia bisons advanced early across the Behring Isthmus (that then connected Asia with North America) into the New World. There the bisons developed several types, and stretched their range down to the Isthmus of Panama. One of these Bisontine species (*Bos latifrons*) of the Southern United States developed during the Pleistocene period into a very large animal, with enormous horns. It is thought that when the bony core was covered with its horny envelope the horns must have measured along the curve at least 5 ft. from the base of the horn core to the tip of the horn! This is very different from the 12 in. to the 20 in. of the modern American bison's horns.

From the first great area of Bisontine development in Central Asia a form of bison known as *Bos priscus* (this being also the name given to the earliest species that entered America) wandered westwards as well as eastwards, and spread right across Central

[1] Though the Cephalophines, which at the present day are mostly small antelopes in Africa and (one species) in India, have specialised in one or two points, they stand very near to the primal stock from which all the ringed-horned antelopes arose.

Europe as far west as England, as far south as Spain and Italy, and as far north as the coasts of the Baltic. It inhabited the whole of Russia, except, perhaps, those portions that were under ice. Its degenerate descendants known as *Bos bonasus*, or the European bison, still linger to the extent of a few hundred in Polish (Lithuanian) forests and in the Caucasus. The modern bisons in America and Europe differ from other cattle in the exaggeration of the spines growing up from the vertebræ at the end of the neck and beginning of the back. These serve to support a hump that is more or less evident, and which is sometimes added to enormously by an immense growth of fat and muscle. In the bison the horn cores are set very widely apart. There is also a tendency to develop excessive growth of hair on the forehead, under the chin, and along the neck.

Bos priscus. The Extinct European Bison

Bos priscus differed from modern European bisons in the much longer and straighter horns, the ends of which were turned up and slightly back as they are in the existing bison of Poland and the Caucasus. It was also much larger in size than the modern form. It did co-exist in Britain with early man, but disappeared not long after man's arrival, giving way, no doubt, in part before the rivalry of the larger and more powerful aurochs. It does not appear to have reached Scotland, and its remains have never been found in Ireland. Its northern limit, as was the case with the lion and so many other beasts, was the county of Yorkshire. Westwards it seems to have extended to the borders of Wales. On the Continent of Europe it lingered on far into the Historical Epoch. It abounded in France in extraordinary numbers, and has constantly been depicted by Prehistoric man.

In Germany, the Balkan Peninsula, and Russia (where, no doubt, it was actually differentiating into the existing type, *Bos bonasus*) it was still abundant down to the Middle Ages. It was

well known to the early Aryans, and its names in Gothic (Wisent) and Greek (Bison) are obviously akin.[1]

Bos taurus primigenius. The Urus or Aurochs

This magnificent beast was known to the Romans through their conquests of Gaul, Germany, and Austria. They found that it was called by the Gothic races Ur or Aur. This they Latinised into Urus, while the name descended into modern German in the forms of Aurochs (*i.e.*, Ur Ox). The Canton of Uri, in Switzerland, was named after this creature, which once inhabited its forested mountains. The Aurochs, or *Bos taurus primigenius*, is the culmination of the Taurine type of the Bovine genus, and, like nearly everything else, has to be referred back for its origin to Asia, and in Asia to India. Here it seems to have arisen from the Bibovine stock, very near to where the Bisontine forms branch off; in fact, there is a good deal of kinship in origin between the Taurine and Bisontine races, in both of which the horns are rather more cylindrical and less flattened or less angular than in the buffaloes. In both these groups, moreover, there is a great tendency to excessive growth of the shaggy hair on the head and neck of the male. Where the horns of the Taurine stock differ from the other groups is also in their tendency to a forward direction. This is by no

[1] It is a great pity that some reformer cannot arise in the United States to rectify the incorrect nomenclature of our American brothers, a nomenclature due in some instances to actual perversity and "contradictiousness." As the word *buffalo* has been applied for many centuries to the most primitive group of cattle existing in Asia and Africa only, and as the name *bison* has such an interesting Aryan pedigree, and was always applied in ancient times to this distinct group of high-shouldered, heavily-maned oxen (the only group that ever reached America), it is a pity that Americans still persist in writing and speaking of *buffaloes* where they ought to use the word *bison*. In the same way they persist in giving the Scandinavian name of *elk* to American red deer, which we know as the *wapiti*, from a Canadian Indian word. The American *antelope* (prongbuck) is not an antelope, the *puma* is not a *lion* or a *panther*, and the *jaguar* is not a *tiger*. Whilst they continue to use the English language they might at least strive to apply the correct English name to their indigenous animals.

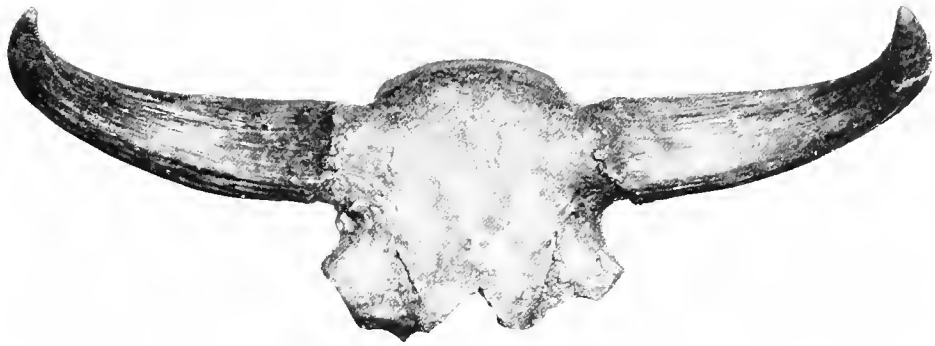


Photo by W. P. Dando, F.Z.S.

HORNS OF EXTINCT ENGLISH BISON (*Bos priscus*).

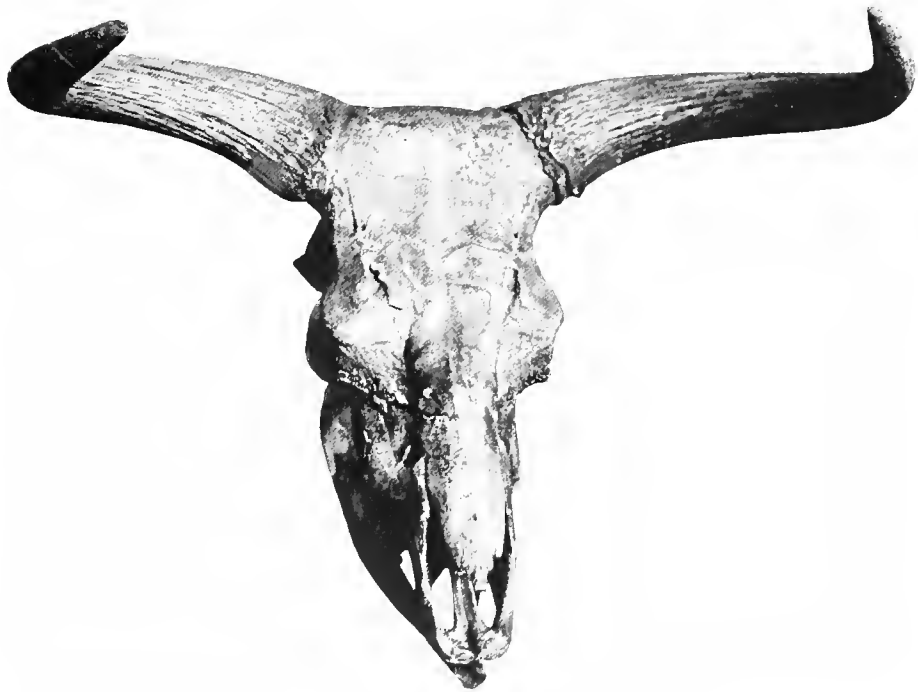


Photo by W. P. Dando, F.Z.S.

SKULL OF EXTINCT AUROCHS (*Bos primigenius*).

To face p. 356.

means universal amongst the Taurine group. It is never met with in the kindred species *Bos indicus*,[1] which has had something to do with the foundations of our breeds of domestic cattle. There is some slight indication of this forward direction of the horn tips in the yak, in the bisons, and in the East Asian Bibovines. In all these cases, however, the forward direction of the horns is much more associated with their upward than with their horizontal growth. In a magnificent extinct species of Taurine ox (*Bos acutifrons*) which developed enormous horns in India (each core of which may have been 5 ft. long) the horns first grew out at right angles from the median line of the skull, but then, instead of curling round and forwards, they drooped down at the sides, each forming nearly a half-circle in its growth. A primitive type of Taurine ox (*Bos namadicus*) existed in Southern England during the Pleistocene period, and its remains are associated with human flint weapons. From India *Bos taurus* spread in its wild form into Northern Africa and Central and Western Europe. No form of this type ever reached America (as a wild species).

The original wild form of *Bos indicus* is completely extinct. This was, perhaps, the first of the two Taurine species to be domesticated, and in this condition it early reached the Mediterranean Basin and North-east Africa. The wild forms of *Bos taurus* in North Africa (*Bos taurus mauritanicus*) also seem to have been domesticated locally, when the earliest types of Caucasian races established themselves in that part of the Mediterranean Basin, and in ancient—indeed, in modern—Egypt we have descendants of the two principal stocks of domesticated cattle, the Taurine and the Indicine, co-existing and mingling. The Mauritanian cattle descended from the North African *Bos taurus* are generally to be distinguished by the smoothness of their coat and their uniform mouse-colour deepening into blackish-brown.

In fact, the coloration in this breed is very much what

[1] *Bos indicus* is nearest, perhaps, to *Bos taurus*, but it also displays slight traces of affinity with the Bibovine (Gaur-Gayal) group.

we see in the Jersey cow—a race which is actually descended through many divagations from this African stock. Early types of domesticated *Bos indicus* that reached Egypt do not seem to have had much of a hump, though there was a tendency to height at the withers. In their earliest form they are more archaic, perhaps, in appearance than the modern domestic cattle of India, and are represented at the present day by the Gala ox, a breed possessing enormous horns, in shape and turn very like those of the yak in some examples, or of the Bibovine group in others. The Gala ox was the earliest breed of domestic cattle in Africa, and is met with to-day in its purest type in Abyssinia, Galaland, and the western part of the Uganda Protectorate. It was succeeded by a more modern Indian type equivalent to the Indian zebu, which apparently proved more suited to the climate of Tropical Africa. From Egypt, and perhaps from India, strains of this Indian type of ox permeated our European domestic cattle. In Europe (allowing for this slight Oriental mixture) the stocks of domestic cattle are descended from the two forms of *Bos taurus*—namely, from the shaggy, black or red aurochs, and from the smooth, mouse-coloured, Mauritanian ox. Perhaps, as already remarked, in the east of Europe, and permeating westwards, there may have been a strain of Indian blood.

The aurochs, or northern form of *Bos taurus*, was probably a larger animal than the Mauritanian ox.[1] In its finest development in Britain and Germany it was a splendid monster, about twice the size of a big bull of the domestic breed. The head was long, especially in the facial portion, the nose being much longer than in *Bos indicus*, or perhaps than in the Mauritanian variety of *Bos*

[1] In this form the head was shorter; the horn cores did not curve so much forward, but more downwards (a trait which often persists and comes out in the cross-strains of European breeds), and the limbs were longer and more slender. The Mauritanian ox may, on the whole, be taken to be the chief source from which the breeds of Spanish, early Egyptian, Syrian, and perhaps Hungarian cattle were derived. This breed may also have been introduced at an early date into Southern Italy, though it is probable that most of the Roman cattle were derived from the northern aurochs.

Photo by Sir John Kirk, G C.M.G., in Woburn Park.

EUROPEAN BISON (*Bos bonasus*) FROM LITHUANIA.

Photo by the Scholastic Photo Company.

HEAD OF ENGLISH WILD BULL (CHARTLEY BREED) (*Bos taurus*).

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taurus. In one specimen found in Britain the length of the face from the frontal ridge between the horns to the tip of the palate was 3 ft. The height of this animal at the shoulder must have been from 7 ft. to 8 ft. As 11 ft. from the shoulder to the ground is considered the height of a large elephant, it will be seen that Cæsar, in comparing the wild bulls of the Black Forest (which probably stood 8 ft. from the ground) to elephants, was not greatly exaggerating.[1]

The horns of the urus bull of the race found in Britain measured in some examples as much as 38 in. along the outer curve of the horn core, which, allowing for the horny sheath, would give a length of nearly 4 ft. to each horn measured along the curve. In some specimens there was a space of 42 in. in the span of the horns measured across the forehead from tip to tip. In colour the British urus may have been red or it may have been black. It has already been stated that the original colour of the Mauritanian form was probably dun-gray.

The last urus which survived as a wild animal in Europe was slain in 1627 in the forest of Jaktorowka, forty miles south-west of Warsaw, in Poland. A little prior to 1550, Baron Herberstain made, or caused to be made, a picture of a Polish aurochs (possibly of this forest of Jaktorowka), and this picture is preserved in his book (written in Latin and translated into Italian) on Muscovy and Russia.[2] According to Herberstain, the colour of this Polish aurochs was black. On the other hand, there is a great deal of evidence deduced from our domestic breeds to show that one variety of the ancestral ox was red (the common ground colour for oxen and their allies the tragelaphs ; perhaps also for the deer, the giraffe, the chevrotain, the pig, and many more primitive Ungulates). In numerous mammals,

[1] *Cæsar, De Bello Gallico*, 6th book, p. 26, where in his description the phrase used may be translated : "These (*Uri*) were little below elephants in magnitude."

[2] The Italian version of the work is entitled *Commentarii della Muscovia et parimente della Russia, tradotti novamente di latino in lingua Italiana*, by Baron S. Herberstain. Venice, 1550.

however, there is an easy oscillation between foxy-red and black. Even in our own order we may not only see the oscillation between red and black in the hair of the chimpanzee on the one hand, and the orang utan on the other, but gorillas have a tendency to remain undecided between the two tints in the colour of their coat, while in primitive man there was unquestionably a black-haired type and a red-haired type ; reddish hair even crops out in the Congo pygmies. It is not only possible, therefore, that there were many local breeds of urus which may have been black- or red-haired (in contradistinction to the dun-colour of the southern form), but there was a tendency in these same animals to produce white examples which were not albinos, and which retained a few marks of dark colour about them on the muzzle, ears, nose, and feet. These dark marks on the white forehead were sometimes black and sometimes red. On the other hand, in the Mauritanian ox these same places on muzzle, ears, nose, and edge of hoofs are often white.

In the British Islands the urus made its appearance in the Pleistocene period, and seems by its rivalry in size and strength to have made life impossible for the bison. The range of the urus in Britain extended far up into the north of Scotland. The urus seems never to have reached Ireland in its original form, only in that of its modified and perhaps partially domesticated descendants, the Keltic short horn (*Bos taurus longifrons*). In Britain the urus certainly lived as a huge wild animal well into Neolithic times, and may even not have become wholly extinct in Scotland until about the beginning of the Christian era. Wild bulls and wild cattle, generally identical with or extremely like the few herds that now survive under the rather misleading name of "Chillingham" or park cattle, were probably of mixed origin. Some of them, such as the Cadzow breed of Western Scotland, may be directly descended from one variety of the wild urus, restricted space having brought about in-and-in breeding and a great decrease of size. Elsewhere the breeds of wild cattle (which are constantly mentioned by Norman writers as existing in Epping Forest and other districts con-

tiguous to London) seem more to have been the descendants of cattle run wild, and these feral oxen may have been of mixed blood—urus and its modified descendant the Keltic short horn, together with breeds of Italian cattle contributed by the Romans (these cattle also being descendants of the urus). These, in fact, were the parent stocks of the English wild cattle of recent historical times, and of to-day.

The Keltic short horn, to which many names have been given, is, according to some zoologists, a domesticated breed of oxen resulting from degenerate tamed races of aurochs mixed with imported "Indian" domestic cattle from Egypt and Asia. The more probable explanation of the variety, at any rate in the British Islands, seems to be that it is nothing but a degenerate urus, perhaps orginating in a small breed of that monstrous ox in some restricted mountain country which became more easily tamed by savage man, and which may have accompanied the Neolithic peoples in their march towards Britain from France and Germany. It is true that remains of *Bos taurus longifrons* are found abundantly in Ireland, under conditions and with associations which seem to indicate a perfectly wild condition. Remains of the same dwarfed ox have also been found in England associated with the bones of the mammoth, but these English remains are not sufficient to determine precisely whether they refer to a small form of bison or to a dwarfed type of urus. From what we know of mammoth remains in Ireland it is quite conceivable that that elephant may have lingered on till the arrival of Neolithic man with his half-domesticated breeds of dwarfed urus.

The British "wild" cattle of to-day are found in the purest form, that is to say, with the greatest likeness to wild animals, in the forest of Cadzow, the ancient seat of the Dukes of Hamilton in Lanarkshire (South-west Scotland). They lingered also down to the 'seventies of the nineteenth century in the parks of Kincardine, Stirling, and Cumbernauld, and at Drumlanrig, in Dumfriesshire. In most of these Scotch parks, however, they have died out or become mingled with other stock, with

the exception of Cadzow, where they still remain a type well worth studying.[1] In England they are kept at Chillingham, in Northumberlandshire; Lyme Park, in Cheshire; Chartley (Earl Ferrers' place in Staffordshire); and at Vaynol (Mr. Assheton-Smith's place in North Wales). I rather think, however, that at Vaynol they have been introduced. The colours of the Cadzow wild cattle are white with black ears, black muzzles, and black often on the lower part of the front legs. There are often flecks of black about the head and fore quarters. The Chartley cattle have black ears. Those at Lyme and Chillingham Park are white with red ears. At Chillingham, in Northumberlandshire, where the cattle have somewhat unjustly given their name to this feral breed of the British Islands, the colour of the ears and muzzle may be either black or red. But in all these parks there is a great tendency for coloured calves to be dropped that are either red or black or dun. As these are invariably killed, the breed, of course, is kept white artificially; otherwise it is quite conceivable that it might revert to colour. Hector Boethius, or Boece, who wrote about 1526, describes the wild cattle of the Caledonian forests as being white, and shaggy like lions. Domestic cattle that have run wild in various parts of the world have often turned to a uniform white breed with black ears and points.

The white wild cattle of England may be said to differ from the urus, chiefly (1) in their much smaller size—they are as big as fairly large domestic breeds; (2) in their proportionately shorter limbs; (3) possibly in their colour; and (4) in the proportionate size of the horns in the male. In the pure breed, however, as shown by examples from Cadzow and Chartley, the horns of the female agree almost exactly with the little we know of the horns of the female urus—that is to say, they bend forward, and then turn upwards and backwards with a slight twist. The horns of the bull (when of pure breed) are remarkably like those of the urus in shape and direction, only, of course, they

[1] The picture of wild cattle which I have drawn for this book is intended to illustrate the Cadzow breed

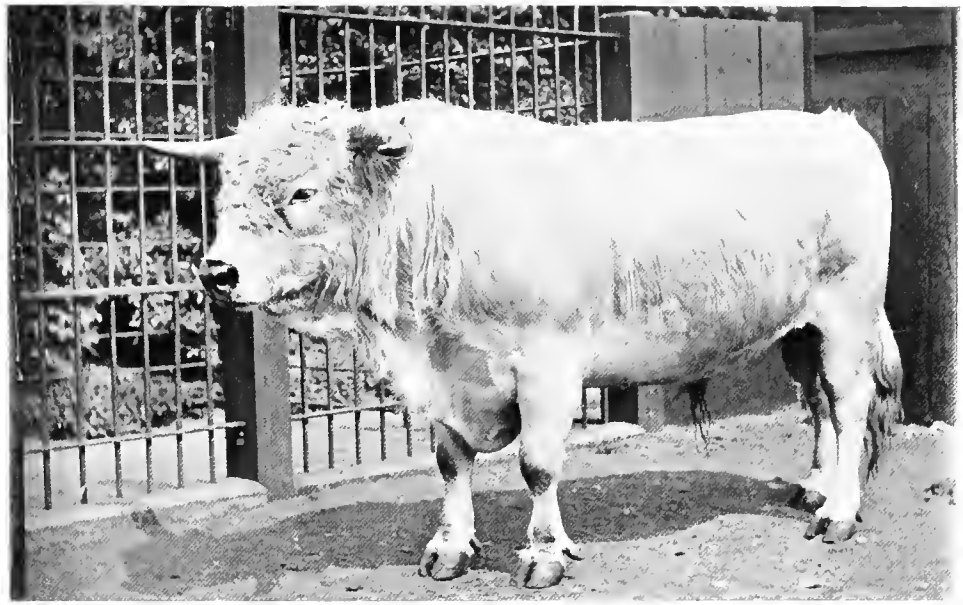

Photo by the Scholastic Photo Company.

ENGLISH WILD CATTLE: BULL, CHARTLEY BREED (*Bos taurus*).

Photo by the Scholastic Photo Company.

ENGLISH WILD CATTLE: COW AND CALF (CHARTLEY BREED).

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are not so long. In fact, the English wild cattle of to-day bear much the same relation to the urus as the pariah dog of (say) the west of Ireland bears to the wolf. It is derived direct from the wolf with scarcely any intermixture of other blood, and yet is degenerate, differing from it only in smaller size, in bigger brain capacity, and in the lesser bushiness of the tail.

The habits of these white cattle are those of wild animals. The bulls are even dangerous sometimes to passers-by. As a rule, however, they run away at the sight of man, and it is almost as difficult to approach them as if they were African antelopes. In the summer they generally feed at night-time, basking in the day in the long fern or grass. They also sleep a good deal during the daytime. The cows hide their young in thickets, or brushwood, until they are old enough to feed with the rest of the herd. The whole herd is ready to make common cause in defence of a single calf. When they move about from pasture to pasture, and the calves are old enough to travel, they generally move inside the herd, with their mothers on the outside of the troop and the bull patriarch leading. In the winter-time bulls, cows, and calves mix indiscriminately in the herd. When the breeding season (the spring) draws near, there are fierce battles amongst the bulls for the possession of the cows, battles which often cost the life of the vanquished, which, if only wounded, is said to be done to death by the others. In the natural life of these cattle, where polygamy is the rule and castration does not solve the difficulty of the unsuccessful males, it is obvious that it is for the benefit of the herd that these unnecessary drones should be killed. They are often, no doubt, driven to lead solitary lives where they may easily fall a prey to the attacks of carnivorous beasts. In fact, it is mainly on these solitary males, in countries where big Carnivores still exist, that lions, tigers, leopards, lynxes, wolves, and bears subsist. If the whole herd is in harmony, or if a female or calf is attacked, success on the part of the Carnivores is very doubtful.

Except in coloration, and perhaps in increased shagginess, there is little difference between the English park cattle and the

Highland breeds of domestic cattle in Scotland. Authorities like Mr. Lydekker are decidedly of opinion that these red and black Highland cattle (their colours are noteworthy) may be descended almost directly from the wild urus, of which they are little else than a form degenerate in size. In Ireland and Wales, and in Prehistoric Britain, the domestic cattle are less directly connected with the urus, which in Wales and South Britain (as on the Continent) appears to have dwindled into a dwarf race, the Keltic short horn (*Bos taurus longifrons*). The little black Kerry cattle, and the similar breeds in Wales, represent this degenerate urus at the present day, and this Keltic short horn was the main stock of the domestic cattle in Northern and Central Europe. In Eastern Europe it is supposed occasionally to have mingled with the domestic cattle received from Syria or Egypt, and descended from the Indian stock, and this strain of Indian blood has markedly shortened the head. In Germany and Hungary many of the types of domestic cattle were and are of very large size, and much like the urus, except that the horns have a tendency to undulate. The Roman cattle also seem to have been derived from the northern urus; but in Southern Italy, Southern and Western France, Spain, and North Africa, the cattle have descended mainly from the Mauritanian ox, though in Spain there seems to have been an intermixture between this type and the northern urus. All these breeds have at different times reached England by way of Germany, Holland, France, and Spain, and have all played their part in evolving the many modern types of domestic cattle in these islands, grafting their own features on to a domesticated stock already in existence, which was the child or the grandchild of the native urus.

Photo by C. Reid.

DOMESTIC CATTLE: KERRY BULL (*Bos taurus longifrons*).

Allied to the Keltic Shorthorn.

Photo by C. Reid.

DOMESTIC CATTLE: LONG HORN BULL.

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CHAPTER XV

ORDER: *PRIMATES.* LEMURS, MONKEYS, AND MAN

THIS group, which has given birth to the lord of Creation, might from its earliest inception be described as the Handed Mammals, the beasts whose fore paws were more or less developed into that great agent of the brain, the hand. In this group there was also from the earliest times a tendency to use the hind limbs as the principal supports of the body, and even the main agents of locomotion, so that a more or less erect position might be assumed, and the extremities of the fore limbs be left free to grasp, to examine, to fight,[1] to manipulate, and to throw. This tendency, which is pointing to inconceivable results in producing man, originated very far back in the history of the Mammalia. An inclination in the same direction may even be observed in Amphibians, and this nascent differentiation between hand and foot was, no doubt, continued through those early forms of reptile which connect the Amphibian with the Mammal. Such primitive types of Marsupial as the opossums of America and the phalangers of Australasia (which last, except in their very specialised dentition, are strongly suggestive of the lemur) may be mentioned as early foreshadowings of the Handed Mammal.

The *Primates*, as an order, date back to very early times, perhaps to the end of the Secondary Epoch. They seem to

[1] The galago, an African lemur, boxes with its hands like a man. Most apes and monkeys fight with their hands as much as with their teeth.

have originated in North America from that basal stock of the Mammalia not far removed from the Monotremes which gave rise to the Marsupials, the primitive Carnivora, the Insectivores, the Ungulates, and the Rodents. The earliest Primates, more or less related to the modern Lemurs, seem in their origin not to have been far from the Ungulates, Rodents, and Insectivores, and indeed to have proceeded in their development on curiously parallel lines with these groups, especially with the Ungulate and Insectivorous Mammals.

The appearance of lemurs in Europe (including Britain) dates from the Earliest Eocene, and probably rapidly succeeded their evolution in North America. It would seem, indeed, as though at the commencement of the Tertiary Epoch there was a continuous land connection between North America (*viâ* Newfoundland, Iceland, and the Hebrides) with Britain.[1] The Lemuroids attained a remarkable development in France, and from this part of West-central Europe the early Primates seem to have spread across the Mediterranean Basin into Africa, and possibly along the coasts of Arabia to India, Ceylon, and Malaysia. Their development in North America (which was a remarkable one) led seemingly to nothing. At that period North America seems to have been cut off from South America, and so far as is yet known no form of lemur ever reached South America. Their development, in fact, so far as the future of monkeys and man was concerned, seems to have been limited to Eurafrica. Only a few straggling forms reached Tropical Asia, where they have become highly specialised (*Loris* and *Nycticebus*). In Africa, probably, the lemur developed first of all into that type of monkey which is now associated exclusively with South America, and which is known as the Platyrrhine.[2] A trace of

[1] The nucleus of the British Islands—Ireland, Cornwall, Wales, and Northern Scotland—appears, indeed, to have been, down to the Secondary Epoch, an outpost of America. England was little more than the alluvium formed by the washing down of the rocks of Cambria and Caledonia; England, in fact, is made up of the detritus of Cornwall, Wales, and Scotland.

[2] These South American monkeys differ from those of the Old World in

this transition from lemur to monkey has been found by Dr. Forsyth Major in the early Tertiary strata of Madagascar, and named by him *Nesopithecus*. Although this creature is specialised as regards the dentition of the lower jaw, it stands very near the transitional type between the lemur and the monkey. It may be supposed that this early type of South American monkey first developed in and spread over Tropical Africa, and passed thence (driven out, possibly, before the more highly-developed, narrow-nosed family, the Catarrhines) across the land bridge which once connected West Africa with Venezuela, and so reached South America.

In previous chapters of this book the former extension of the Antarctic Continent has been dwelt on, and it has been shown that there are good reasons to suppose that it connected South America with New Zealand and Australia, but not with South Africa. At the same time there are equally good reasons to postulate the existence in early Tertiary times of a land bridge connecting Venezuela and Brazil with Western Africa ; and it has therefore been argued that the resemblances between the Madagascar (as representing the primitive African) fauna and the South American and Australian vertebrates and land invertebrates may be explained by their migration to and from South America and Africa by means of this Equatorial land bridge, and not by the connection between the Cape Peninsula and Antarctica, a connection which is rendered problematical by the great depths of the intervening sea. In this manner the South American Continent became peopled with those early representatives of the sub-order *Simiæ*—the American monkeys. It would therefore seem as though the Primates, having originated in North America (at that time completely cut off from the southern part of the hemisphere), travelled first to Europe, then to Africa, and thence penetrated South America in the form of the Platyrrhine monkeys. By this time the land connection through Antarctica between South

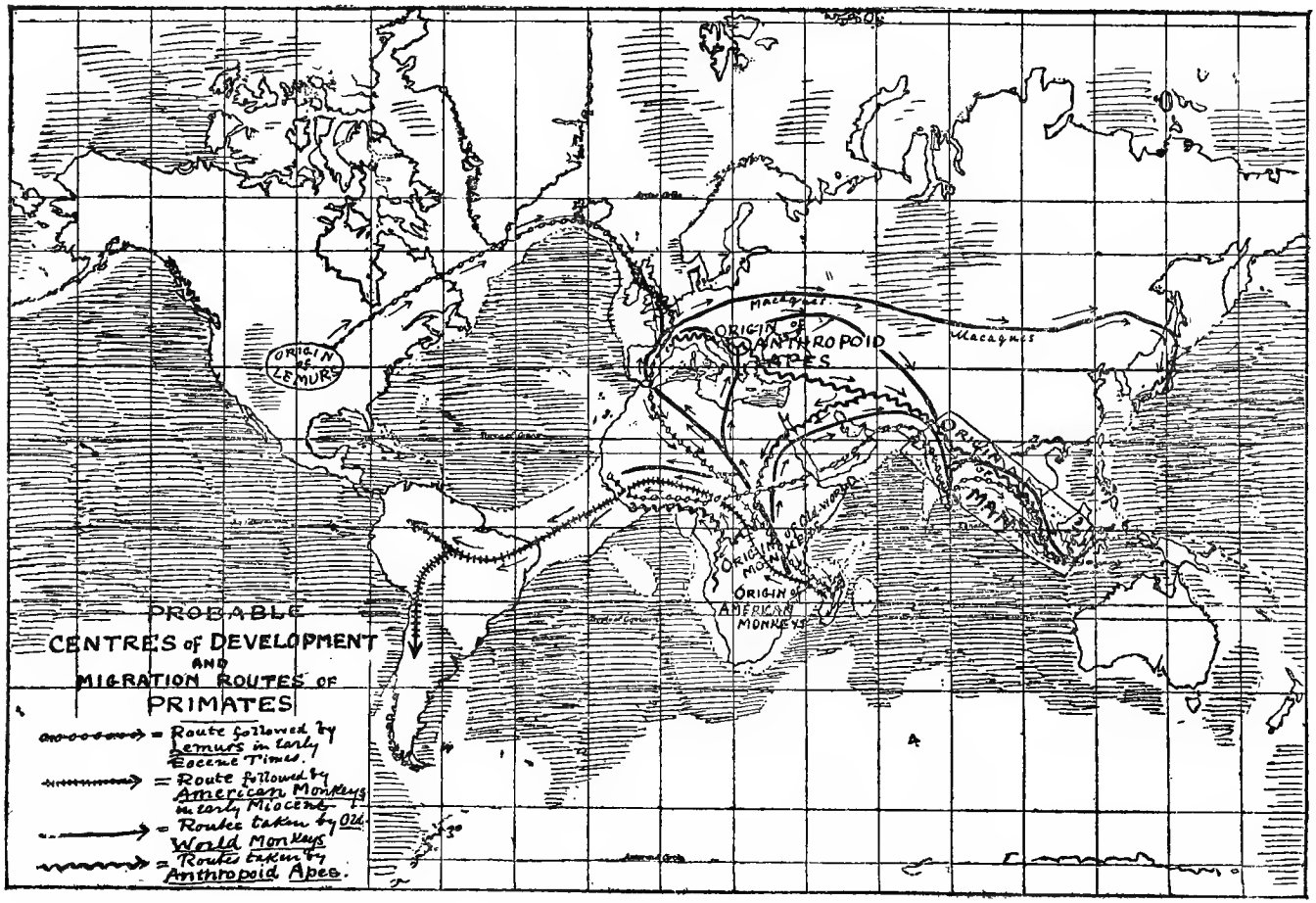
their broad noses, the number of their molar and premolar teeth (they always have three pairs of premolars instead of the two found in other monkeys and in man), and in some other particulars.

America and Australasia had ceased. Therefore, although the South American monkeys reached as far south in that continent as the Rio de la Plata, they never spread into Australasia.[1]

It is possible, also, that in Africa from the basal stock of the Platyrrhines arose the Catarrhines, or Old World apes, distinguished from the New World monkeys by the presence of only two pairs of premolars in the dentition, by the narrow nose, by the structure of the bony supports to the ears, and several other features in the skull. Africa, therefore, may have originated the True Apes, the direct ancestors of man. The competition between the lemurs, on the one hand, and their more perfected descendants, the Platyrrhines and Catarrhines, drove the former southwards and eastwards into that projection of the African Continent which is now the island of Madagascar, leaving at the present day only a few isolated species of lemur on the main continent of Tropical Africa. Madagascar was cut off from Africa by the sea during the Tertiary Epoch, and at a time before it could receive any form of real monkey. Thenceforth Madagascar remained the great home of the lemurs, many genera of which attained extraordinary specialisation. Thus the lemurs originated in North America, but have found their final resting-place in a large island several hundred miles off the east coast of Africa!

The Catarrhine monkeys, having originated in Africa, where by far the preponderating number of types are found at the present day, spread northwards to the Mediterranean, Europe, and across Arabia and Syria into Asia. Prior to this migration they were probably sufficiently differentiated to represent the parent types of the genera *Semnopithecus*, *Macacus*, *Cynocephalus*, and the sub-family of the anthropoid apes. In Central and Southern Europe the anthropoid apes appear first to have emerged distinctly from the mere monkey, and, together with

[1] The present and Pleistocene distribution of the South American monkeys strongly suggests their African origin. They are most numerous in species in the north-eastern part of the South American Continent (Brazil), though they penetrated as far south as Patagonia.


ORIGIN of LEMURS
ORIGIN of ANTHROPOID APES
Macaques
Macaques
ORIGIN of OLD WORLD MONKEYS
ORIGIN of AMERICAN MONKEYS
PROBABLE CENTRES of DEVELOPMENT AND MIGRATION ROUTES of PRIMATES
= Route followed by Lemurs in early Eocene Times.
= Route followed by American Monkeys in early Miocene
= Route taken by Old World Monkeys
= Route taken by Anthropoid Apes.

the baboons, the *Semnopitheci* (or long-tailed entellus monkeys) and the macaques, to have reached India and Tropical Asia. In India, man himself seems to have grown out of an early genus of the anthropoid apes, and from Tropical Asia he went forth to conquer the world and to spread into every habitable portion of the globe.

In the middle of the Tertiary Epoch monkeys very similar to the macaques and *Semnopitheci*, as well as later forms actually identical with the genera *Semnopithecus* and *Macacus*, lived in large numbers in Southern, Central, and Western Europe, especially in France, Germany, Italy, Hungary, and Greece. One of these forms (*Oreopithecus*), a native of Italy, seems to have been in the direct line of man's ascent. It is noteworthy that it possessed no largely developed canine, and that its teeth, like those of man, were without a diastema, or open space separating one tooth from another. A species of *Macacus*, tentatively called *pliocenus*, inhabited England in the early part of the Pleistocene period, and may just possibly have been contemporaneous in the Thames Valley with the first arrivals of Palæolithic man. This genus *Macacus*, which is now mainly Asiatic in its range (and which is the only monkey inhabiting north temperate regions with a climate as cold as England), is the only representative of its family still existing in Europe, for one species of macaque inhabits the rock of Gibraltar as well as the adjoining regions of North Africa. Its presence there has been ascribed to the agency of man, but there is every reason to suppose the contrary, especially as its fossil remains are found in Gibraltar caves and elsewhere in Southern Spain. This is possibly identical with the species of macaque that once inhabited Essex, and no doubt other parts of Southern England.

FAMILY: *HOMINIDÆ*. MANKIND

Man agrees with the Old World apes and monkeys in the number and character of his teeth, though he differs from the majority of these allies in never showing any diastema, or open

space between the placing of the teeth, and in the small development of the canines, which project but little, if at all, beyond the line of the incisors and premolars. He is also able to assume without difficulty the erect position, and to walk erect without stooping or shambling. His body, moreover, as compared with apes and monkeys, is nearly hairless. Like them, he has no outward tail, the tail bones being tucked under the pelvis, or basin. Unlike them, the first toe in the feet can no longer be used as an opposable thumb ; it has become the longest and biggest toe of the foot. On it the chief weight is thrown in walking, and the rest of the toes are tending towards disappearance, so that man is on his way to becoming a one-toed animal, not by the extreme development of the middle toe, as in the horse, but by the extravagant growth of that first toe, which is so often reduced to uselessness or lost altogether in the other Mammalia. There are many slight differences in the structure of man's skeleton and soft parts which separate him from the anthropoid apes and the monkeys, and there is, of course, that wonderful cranial development, which, however, has constantly occurred in past ages in a slighter degree in the development of other Primates—lemurs and American monkeys ; though, owing to the want of help from local circumstances, it resulted in nothing. Putting sentiment aside, it is sometimes questionable whether physiologists should rank the physical difference between man and apes as more than attributable to a sub-family. In the early part of the nineteenth century, before the teaching of Darwin had revolutionised zoological classification, man was placed in an order by himself. On the other hand, in the middle of the eighteenth century the great Swedish naturalist, Linnæus, scarcely regarded the difference between man and the higher apes as more than generic. In the absence of further information, however, regarding the connecting links which once existed between man and the earlier types of anthropoid apes, it is perhaps reasonable to give him a separate family (*Hominidæ*) to himself.

GENUS: *HOMO.* MAN

The nearest approach on the part of the anthropoid apes to the genus *Homo* seems to be represented by *Pithecanthropus*, that man-like creature whose remains were discovered by Dr. Dubois in Tertiary strata of Java. It is practically certain that man did not descend from any of the existing types of anthropoid apes—the gorilla, chimpanzee, orang utan, and gibbon. We must go back apparently to the parent form of the anthropoid apes before we can find a common starting-point. In some respects man resembles the least differentiated among existing anthropoids (the gibbons of Asia), but differs from them again by his small canine teeth, a most persistent human character. The genus *Homo*, from such indications as we possess, would seem to have originated in, or not far from, the peninsula of India, and from that neighbourhood to have branched out into three very distinct types, which, but for their constant intermingling, have every claim to be regarded as distinct species. Accepting them, however, as sub-species, the *Homo sapiens* of Linnæus may for convenience be divided into these three principal types: *Homo sapiens æthiopicus*, *H. sapiens caucasicus*, and *H. sapiens mongolicus*. Perhaps the lowest existing forms of the human race belong to the two first sub-species, and physically these two present more archaic features than the Mongolian. The original stock of *Homo sapiens* before these divergences took place was (we may postulate from the evidence at our command) not unlike the Australian aboriginal or Veddah of Ceylon: a yellow-skinned, prognathous man, with overhanging brows sheltering largish eyes placed rather close together, with a retreating chin and large teeth, especially as regards incisors and molars. He was high-shouldered, short-necked, with long arms, and slightly bowed legs. He was moderately hairy all over the back and outer aspect of the limbs and breast in the male, but much less hairy in the female. The head hair was equally long in both sexes, black or occasionally red, with a tendency to curl. There was face hair (a moustache, beard, and whiskers in both sexes, though

much less in the female than in the males). Something like this hypothetical sketch can be seen in the wild Veddahs of Ceylon, who, if we had a Government that cared two straws for unproductive science, would be most carefully preserved and nurtured as an object lesson.

Homo sapiens caucasicus. The White Man

This is the commonest mammal in the British Islands at the present day, with the doubtful exception of the long-tailed field-mouse. It is, perhaps, simplest to style this sub-species in the vernacular the "White man," in contrast to the Yellow man (*Homo sapiens mongolicus*), and the Black man (*Homo sapiens æthiopicus*). But the more primitive types of this sub-species at the present day (and, no doubt, in past times) tend very often to possess a dusky or brownish-yellow skin, though much of their deepening colour is, no doubt, due to ancient intermixture with the Ethiopian race. In some respects the lowest types, fossil and existing, of Caucasic man come nearest to the primal stock of humanity, and are less differentiated from the ape than is the Negro or Mongolian. On the other hand, its highest examples have almost left the class of Mammalia to found a new class of Demigods. The sub-specific name *caucasicus*, or Caucasian, has been much contested, but inasmuch as this type of humanity early attained a very typical form in the races about the Caucasus, and as *europæus* would not comprise a race which dwells also (apart from recent migrations) in Asia and Africa, *caucasicus* is, perhaps, the least inapt designation, as it represents the locality in which the white man probably first became emphatically a white man.

Britain has been inhabited by man since the early part of the Pleistocene period, when he seems to have entered England from Belgium or France, and to have spread northwards and north-westwards into Scotland and Ireland. The Glacial conditions which afflicted Northern Ireland, Scotland, and Northern England during the Pleistocene no doubt much interfered with early man's prosperity and peregrinations in these parts, and

after his first incursion he may have retreated before the ice until conditions became more tolerable. Nevertheless, he would seem certainly to have been contemporaneous in England with the great fauna of Early and Mid-Pleistocene times, and in Ireland to have co-existed with the huge megaceros deer, while his remains in Western Scotland go back to an equally remote antiquity.

The first types of Palæolithic man that invaded these islands were related to that low, almost simian race of Belgium and Germany which we distinguish as the Neanderthaloid type, a type, in all probability, not much different from the generalised Australian aboriginal, who is either a very low Caucasian or a direct descendant of the basal type of humanity. A picture of the living Veddah of Ceylon would give a very fair idea of the aspect of Palæolithic British man. It is possible, however, that there is a Mongoloid element in the British races. Early in the history of mankind an enterprising section of the early Mongolian, or yellow-skinned, straight-haired race boldly attacked the frozen North as it lay under the glaciers of the Pleistocene. Becoming more and more carnivorous, and learning to clothe themselves in the skins of the beasts they killed, and, no doubt, making use of the recently acquired knowledge of fire production, these early Mongoloids (equivalent to the modern Eskimo) apparently ranged round the northern regions of the Old and New Worlds, and came to Britain and France when the cold was still great, but when there were abundant supplies of reindeer, horses, mammoth, and wild cattle to nourish carnivorous man. It is possible that a little Palæolithic blood still lingers in Britain, especially in out-of-the-way parts of Ireland, Wales, and Scotland. It is equally likely that in the same localities there is more than a dash of the Eskimo, giving the broad cheek bones, flattened nose, clumsy build, and peepy eyes of the Hyperborean as seen in the modern Samoieds and Eskimo.

But under more favourable conditions in Western Asia and Southern Europe the Caucasic race had developed that handsome type which it is convenient to call Iberian—the white-skinned,

dark-haired, dark-eyed, hairy man, with a skin which, though tanned by exposure, is still clear enough to show a blush. The dark-haired whites developed the first civilisation, and spread it westwards over the Mediterranean Basin in North Africa and South Europe, having, amongst other things, a passion for raising objects of worship or tombs in the shape of huge erect stones. The dark-haired, white-skinned Iberian spread through France and Southern Germany into Denmark, England, Wales, Ireland, and Scotland, where their descendants may be seen not much differentiated at the present day. They were possibly the Picts of history, while the fairies of legend were undoubtedly the hunted remains of Palæolithic man—the dwarfish descendants of the Australoid and Eskimo aborigines. The Iberian, in short, was Neolithic man, with his vastly improved implements of stone. He too began first to utilise metals.

Then, much later, somewhere in the north of Europe arose a remarkable type of white man, whose origin is still uncertain. He was even paler and clearer-skinned than the Iberian, and consequently more blushing, but he differed notably from this and from all other types of humanity by retaining the gray eyes of infancy, and developing them until the iris was nearly blue in colour. He was also notable for his red, still more his blonde or brown hair. Whether he arose directly as a variety of the primal Caucasian stock, or whether he was originally due to an intermixture with the Mongolian, is uncertain. A tendency to red or to dark brown hair exists in the germ of the human species. Anthropoid apes, our cousins of to-day, not only are reddish-yellow and brown in some genera and black-haired in others, but even black-haired apes, like the gorilla, have a tendency, especially in the female, to develop reddish hairs. The Congo pygmies, who are amongst the lowest type of Negro, also incline towards redness of hair on the head, and the fine down on their bodies is reddish-yellow. Even the Iberians in Afghanistan and North Africa developed a variety with reddish-brown hair and gray eyes. A downright red-haired type of Caucasian man seems to have been an extremely old variety, and is that which is so often

met with in Scotland, Ireland, France, and Portugal, which is, in fact, the only racial type one can associate with the speaking of Keltic languages. The blue-eyed, absolutely golden-haired Aryan, the race found in Scandinavia, in Ancient Greece, in Russia, in Germany, and Anglo-Saxon England, is a marked type of apparently recent birth—recent, that is to say, in the history of human development. This type for the sake of convenience one may style the Aryan, since it is associated with the introduction of the Aryan family of languages.

The next invader of Britain after the Iberian was the red-haired Kelt, who had an Aryan language imposed on him, no doubt by conquest, at the hands of the true golden-haired Aryans. Arriving in Britain from Belgium, having already seemingly differentiated his Keltic vocabulary into two groups,[1] represented by the modern Welsh and Gaelic, he possessed, no doubt, some advantage of physique and weapons, but was nevertheless unable or unwilling completely to exterminate his Iberian predecessors, on whom, however, he imposed his Aryan vocabulary. The children resulting from the mixed marriages between the red-haired Kelt and the black-haired Iberian retained from their mothers the Iberian grammar and structure of their speech. The result is that Welsh and Gaelic represent a curious compromise : the grammar and structure of the tongues are akin to that of the Berber languages, are, in short, North African, while the vocabulary is mainly Aryan or North European. No doubt much the same linguistic compromise was accomplished in France, and perhaps to some lesser extent in Italy and Northern Spain. The only remains of the aboriginal Iberian tongue is modern Basque, spoken in the Pyrenees.

The Brythonic, or British branch of the Keltic group, may also have been the original speech of the flaxen-haired, blue-eyed Belgians who invaded Eastern Britain after the red-haired Kelts.

The Roman invasion introduced a small but powerful element of very diverse origin. There were dark-haired Iberians

[1] Brythonic and Goidhelic.

from Italy, Spain, and Southern Gaul, which reinforced the dark-haired stock in Britain. There were red-headed Kelts and flaxen-haired Belgi also in the Roman armies. Then before the Romans left came the forerunners of the great Teutonic invasion. Yellow-haired, blue-eyed men from Scandinavia, from Western Germany, and Friesland began to settle on the coasts of Scotland and East Anglia, and after the Romans left the Teutonic invasion of Britain and Ireland proceeded apace. The Teutons and Scandinavians were flaxen or red-haired, blue- or gray-eyed northern Aryans, speaking pure Aryan languages. Some of them may have been slightly changed in physique by mixture with the Lapp and the Finn, that mixture which gives such a Mongolian aspect to some of the inhabitants of Eastern Germany and Northern Russia. In the main, however, this was the clearly-defined, good-looking type which we see to-day in the agricultural districts along the coasts of Eastern England and the coast regions all round Ireland. This handsome Scandinavian type remains particularly pure in Ireland at the present day, and is by no means confined to the coast, though not much met with in the centre and south. It is well represented in the Royal Irish Constabulary. It is the best type of Englishman, but is rare in Scotland except in the Shetland Islands and the English borderland. It is easily distinguishable from the many other types of Scotch physiognomy by the lesser prominence of the cheek-bones, the straight and moderately short nose, and the blue eyes. It is curious that this Scandinavian type, so much associated with the best and conventional kind of Englishman, should be most strikingly represented in Ireland.

A slight reinforcement of the Iberian element was probably the outcome of the Norman Conquest. Many of the Normans who invaded England were largely of French extraction and of the dark-haired type. But under the Angevin kings who succeeded to the Norman dynasty considerable numbers of Gascons, Poitevins, and other types of dark Frenchmen entered the country, and being given positions of influence and importance, became the sires of many children, legitimate and illegiti-

mate. Under the Normans, too, and thenceforth down to our own days, Jews and Gipsies entered England, the Jews settling for the most part at the coast towns, while the Gipsies proportionately to their small numbers exerted a remarkable influence over the character of the population in many parts of Essex, Devon, Shropshire, Lancashire, and Southern Scotland. The Gipsies were originally a nomad race of North-western India, belonging to the Caucasian family, of mixed Dravidian, Iberian, and Aryan stock. They infused into parts of England the influence of the dark eyes, dark hair, and lither forms of the eastern Caucasian. The Jewish type has exerted the most influence over parts of Kent, South Hampshire, South Yorkshire, London and its suburbs, and Lancashire. The connection of Bristol and Glasgow with the West Indian trade has actually introduced a slight (and now scarcely traceable) negro element into the population on the banks of the Clyde and the Somersetshire Avon. Numbers of merchants and adventurers from Scotland and Bristol married in the West Indies half-castes, or quadroons or octoroons, and their children—dark-haired, brown-eyed, and vivacious, and not differing very markedly from the Iberian element—have perpetuated this strain in the districts above mentioned. As Ireland has been kept apart from all considerable racial immigration since the invasion of the island by the Norman and English nobility (who, however, brought over numbers of Welsh and a few English and Scotch settlers at different times), it is in Ireland that may be seen most marked and least blurred the main elements of the British population prior to the Norman Conquest—the oldest stock of all (Neanderthaloid and Eskimo), the handsome Iberian, the red-haired Kelt—ugly, but strong, resolute, and grim—the fair-haired Norseman, and the very similar but shorter-statured Anglo-Saxon.

With the exception of the red deer, the common mouse, the brown and the black rats, man is probably the most recently arrived mammal in the British Islands, and his advent and development may fitly close this review.

APPENDIX

LIST OF BRITISH MAMMALIA

For the convenience of readers, a summary is here given of the classification and the scientific and vernacular names of the known British Mammalia. The species which are inhabitants of any parts of the British Islands (or of the sea round about the British Islands) at the present day are printed in black type. Those that are common, or which may be seen in some parts of the British Islands without difficulty, are underlined, in addition to the heavy type. Species that are very doubtful natives of the British Isles are placed between brackets, and are not counted.

It will be noted that out of the 113 recorded species of the British Mammalia since the commencement of the Pleistocene Period, 38 are universally distributed, 35 species are restricted in distribution to England (and possibly Wales), 25 are common to England and Scotland, 11 to England and Ireland, 2 species are entirely restricted to Scotland in their known range, 1 species is common to Ireland and Scotland, and 1 species is only found in Ireland. This gives England (and perhaps Wales) a total, past and present, of 109, Scotland 66, and Ireland only 51.

LIST OF BRITISH MAMMALIA

FROM THE COMMENCEMENT OF THE PLEISTOCENE PERIOD TO THE PRESENT DAY

ORDER, *CETACEÆ.* WHALES and PORPOISES.

SUB-ORDER, *ODONTOCETI.* TOOTHED WHALES.

FAMILY, *DELPHINIDÆ.* DOLPHINS and PORPOISES.

Monodon monoceros. The Narwhal.
(Practically extinct. Found fossil in East Anglia, and recorded within the Historical Period from the coasts of Scotland and Lancashire.)

Delphinapterus leucas. **The Beluga, or White Whale.**
(Northern coasts of Scotland and East coast of England.)

Phocæna communis. **The Common Porpoise.**
(Coasts of Great Britain and Ireland.)

Orca gladiator. **The Common Killer Whale, or Grampus.**
(Seas round British Islands.)

Pseudorca crassidens. The Lesser Killer.
(Extinct. Found fossil in Lincolnshire.)

Globicephalus melas. **The Black Fish, or Pilot or "Ca'ing" Whale.**
(Coasts of Great Britain and Ireland.)

Grampus griseus. **Risso's Grampus.**
(Very rare. Coasts of Great Britain.)

Lagenorhynchus albirostris. **The White-beaked Dolphin.**
(Rare. Coasts of Great Britain and Ireland.)

Lagenorhynchus acutus. **The White-sided Dolphin.**
(Very rare. Northern coasts of Scotland.)

Delphinus Delphis. **The Common Porpoise.**
(Coasts of Southern and Eastern England and Southern Ireland.)

Tursiops tursio. **The Bottle-nosed Dolphin.**
(Rare. Coasts of Great Britain and Ireland.)

FAMILY, *PHYSETERIDÆ.* SPERM and ZIPHIOID WHALES.

Physeter macrocephalus.
(Extinct. Seas round Great Britain and Ireland.)

Hyperoodon rostratus. **The Common or Bottle-nosed Whale.**
(Coasts of Great Britain.)

Ziphius cavirostris. **Cuvier's Whale.**
(Very rare, only one example having been found in British waters, off the mainland of Shetland.)
Mesoplodon bidens. **Sowerby's Whale.**
(Rare. East coasts of Scotland and England.)

SUB-ORDER, *MYSTACOCETI.* WHALEBONE WHALES.

FAMILY, *BALÆNIDÆ.* The RIGHT WHALES.

Balæna australis. The Southern Right Whale.
(Extinct in British waters. Formerly an inhabitant of the seas round the British Islands.)

FAMILY, *BALÆNOPTERIDÆ.* The RORQUALS.
Megaptera boops. **The Hump-backed Whale.**
(Waters round the British Islands. Fairly common.)
Balænoptera musculus. **The Common Rorqual.**
(Waters round the British Islands.)
Balænoptera sibbaldii. **Sibbald's Rorqual, or the Blue Whale.**
(Rare. Occasionally met with in the waters round the coasts of Scotland and the north-east coast of England.)
Balænoptera borealis. **Rudolphi's Rorqual.**
(Rare. Eastern coasts of Scotland and England.)
Balænoptera acuto-rostrata. **The Lesser Rorqual, or Pike Whale.**
(Waters round the British Islands.)

ORDER, *INSECTIVORA.* INSECT-EATING MAMMALS.

FAMILY, *ERINACEIDÆ.* The HEDGEHOGS.

Erinaceus europæus. **The Common Hedgehog.**
(Great Britain, except the Hebrides and Scottish islands. Ireland.)

FAMILY, *TALPIDÆ.* The MOLES.

Talpa europæa. **The Common Mole.**
(England and Wales, most parts of Scotland, including the island of Mull, but not the extreme north of Scotland or the Hebrides. Not found in Ireland.)

FAMILY, *SORICIDÆ.* The SHREWS.

Sorex vulgaris. **The Common Shrew.**
(England and Wales, and most parts of Scotland, except the extreme north and the islands. Not found in Ireland.)

Sorex minutus. **The Lesser or Pygmy Shrew.**

(Rather rare in Northern England. Found all over Scotland, including the Hebrides, and abundantly in Ireland.)

Crossopus fodiens. **The Water Shrew.**

(Common throughout England and Wales. Rare in Scotland, but extends its range to the extreme north. Not found in the Hebrides or the Scotch islands, and absent from Ireland.)

ORDER, *CHEIROPTERA.* The BATS.

SUB-ORDER, *MICROCHEIROPTERA.* INSECT-EATING BATS.

FAMILY, *VESPERTILIONIDÆ.* The TYPICAL BATS.[1]

Vespertilio serotinus. **The Serotine Bat.**

(Distribution confined to a small portion of the south-east of England, where it is not uncommon.)

Vespertilio murinus (discolor). **The Parti-coloured Bat.**

(A doubtful British species. Only one example obtained, at Plymouth.)

Pterygistes noctula. **The Great Bat, or Noctule.**

(Found in England and north-east of Ireland, but not as yet met with in Wales or Scotland.)

Pterygistes leisleri. **The Hairy-armed Bat.**

(Found in England and north-east of Ireland. Not met with in Wales or Scotland.)

Pipistrellus pipistrellus. **The Common Bat, or Pipistrelle.**

(Universally distributed over the British Islands, including the Hebrides and the Isle of Man.)

Myotis dasycneme. **The Rough-legged Bat.**

(Very rare. An occasional visitor to the south of England.)

Myotis daubentoni. **Daubenton's Bat.**

(England, possibly Wales, the south and east of Scotland, the north and east of Ireland.)

Myotis nattereri. **The Reddish-gray Bat.**

(England and Wales, the west of Scotland, and most parts of Ireland.)

Myotis bechsteini. **Bechstein's Bat.**

(Very rare as a British species. Only known specimens captured a hundred years ago in the New Forest, and in 1902 at Henley-on-Thames and in Sussex.)

[1] The nomenclature of the bats—British and European—of the family *Vespertilionidæ* has been much altered recently—since 1898. The former genus, *Vesperugo*, has been divided into the genera *Vespertilio*, *Pterygistes*, and *Pipistrellus*, *Vespertilio* replacing *Vesperugo* by a somewhat fanatical adhesion to the principal of priority (Linnæus first applied that name to the parti-coloured bat). The old *Vespertilio* of the latter half of the nineteenth century is replaced by the still older term *Myotis*.

Myotis myotis. **The Common Continental Bat.**

(Of some uncertainty as a British species. Only specimens caught hitherto found in London, near the British Museum, and in Cambridgeshire. Reported to exist in Dorsetshire and the Isle of Wight.)

Myotis mystacinus. **The Whiskered Bat.**

(Somewhat rare. Recorded from the southern half of England, and reported to be met with in the west of Ireland. Absent from Scotland.)

Myotis emarginatus. **The Notch-eared Bat.**

(Of very doubtful occurrence as a British species. May be found in South England, as it is common in North France.)

Barbastella barbastellus. **The Barbastelle Bat.**

(Met with over the greater part of England. Absent from Scotland and Ireland.)

Plecotus auritus. **The Long-eared Bat.**

(Almost universally distributed over the country districts of England, Ireland, and Scotland. Probably absent from the Hebrides and the Scotch islands.)

FAMILY, *RHINOLOPHIDÆ*. The LEAF-NOSED BATS.

Rhinolophus ferrum-equinum. **The Greater Horseshoe Bat.**

(Distribution limited to the southern half of England.)

Rhinolophus hipposiderus. **The Lesser Horseshoe Bat.**

(Distribution apparently limited to the southern half of England and the western districts of Ireland.)

ORDER, *CARNIVORA*. The FLESH-EATING PREDATORY MAMMALS.

SUB-ORDER, *FISSIPEDIA*. The SEPARATE-TOED CARNIVORES.

FAMILY, *CANIDÆ*. The DOGS.

Lycaon anglicus (?). The English Hunting Dog.

(Extinct. Of not very certain occurrence, but thought to have existed in England and Wales during the Pleistocene Period.)

Canis vulpes. **The Common Fox.**

(Almost universally distributed over the British Islands, except the Hebrides, Shetlands, and Orkneys.)

Canis lupus. The Wolf.

(Extinct. Formerly distributed all over Great Britain and Ireland.)

FAMILY, *URSIDÆ*. The BEARS.

Ursus arctos. The Brown Bear.

(Extinct. Formerly distributed over Great Britain and Ireland, except the Hebrides and Scottish islands.)

[*Ursus horribilis*. The Grizzly Bear.]

(It is thought that remains of this type of bear have been found in Pleistocene deposits in Ireland and England.)

Ursus spelæus. The Cave Bear.

(Extinct. Formerly abundant in the southern half of England and in Wales.)

FAMILY, *PROCYONIDÆ*. The RACCOONS.

Ælurus anglicus. The British Panda.

(Extinct. Inhabited the east and possibly the south of England at the commencement of the Pleistocene Period.)

FAMILY, *MUSTELIDÆ*. The WEASELS.

***Lutra vulgaris*. The Common Otter.**

(Found in the wilder parts of England, all Scotch rivers and sea coasts, Welsh and Irish rivers and coasts.)

***Meles taxus*. The Common Badger.**

(Scarce in the more inhabited districts of England, but fairly common in Wales, Scotland, Ireland, and the Isle of Man. Absent from the Hebrides and the Scotch islands.)

Gulo luscus. The Glutton.

(Extinct. Distribution probably limited in former times to England, Wales, and south of Scotland.)

***Mustela martes*. The Pine Marten.**

(Scarce in England and Wales, except in the wilder forested parts. Found in Scottish Highlands, and until recently in the Hebrides. Fairly abundant throughout Ireland.)

***Putorius fœtidus*. The Common Polecat.**

(Very scarce in England, except in the wilder parts. Found in Scotland, but absent from the Hebrides and the large Scottish islands, and from Ireland.)

***Putorius ermineus*. The Stoat, or Ermine.**

(Common throughout England, Wales, and Scotland, but not found in Ireland or the Hebrides.)

***Putorius hibernicus*. The Irish Stoat.**

(Range entirely restricted to Ireland.)

Putorius nivalis. **The Weasel.**

(Common throughout England, Wales, and most parts of Scotland, except the extreme north and the islands. Not found in Ireland.)

FAMILY, *HYÆNIDÆ*. The HYÆNAS.

Hyæna striata. The Striped Hyæna.

(Extinct. Inhabited Eastern England at commencement of Pleistocene Period.)

Hyæna crocuta. The Spotted Hyæna.

(Extinct. Very common throughout the Pleistocene Period in England and Wales. Absent from Scotland and Ireland.)

FAMILY, *MACHAIRODONTIDÆ*. The SABRE-TOOTHED CATS.

Machairodus latidens. The Broad-tusked Machairodont.

(Extinct. Inhabited east and south of England in the early Pleistocene.)

Machairodus cultridens. The Sabre-toothed "Tiger."

(Extinct. ? East of England in early Pleistocene.)

FAMILY, *FELIDÆ*. The TRUE CATS.

Felis leo (*Felis spelæa*). The Lion (sometimes called the Cave Lion.)

(Extinct. Very abundant throughout England and Wales during the Pleistocene and Prehistoric Periods. Absent from Scotland and Ireland.)

Felis pardus. The Leopard.

(Extinct. Remains found in no great abundance in south and south-west of England during the Pleistocene Period.)

Felis lynx. The European or Common Lynx.

(Extinct. Inhabited England, and probably Southern Scotland, during the Pleistocene Period, and lingered down to the verge of the Historical Epoch.)

Felis brevirostris. The Short-faced Lynx.

(Extinct. Inhabited parts of England at the commencement of the Pleistocene Period.)

Felis caffra. The Egyptian Cat.

(Extinct. Inhabited Southern England in the Pleistocene Period.)

Felis catus. **The Wild Cat.**

(Nearly extinct. Only lingering in the north of Scotland. Formerly abundant throughout all Great Britain, but absent from Ireland.)

SUB-ORDER, *PINNIPEDIA*. The MARINE CARNIVORA.

FAMILY, *TRICHECHIDÆ*. The WALRUSES.

Odobænus rosmarus. The Walrus.

(Practically extinct as a British species. In the Pleistocene Period frequented the east coasts of England, and was met with occasionally off the northern coasts of Scotland down to 1857. Not reported to have occurred off Ireland.)

***Phoca vitulina*. The Common Seal.**

(South-west and north coasts of England, coasts of Wales, Scotland, and Ireland.)

***Phoca grœnlandica*. The Harp Seal.**

(Almost extinct in British waters. Formerly met with off the coasts of England, Scotland, and Ireland.)

***Phoca hispida*. The Ringed Seal.**

(Very scarce. Occasionally met with on coasts of Hebrides, North-east Scotland, and Eastern England.)

Phoca barbata. The Bearded Seal.

(Probably extinct. Reported from Hebrides coast fifty years ago. Found fossil in Eastern England.)

***Halichœrus grypus*. The Gray Seal.**

(Fairly abundant off the south-west and north coasts of Ireland, and the coasts of Scotland and of all the large islands, including the Hebrides. Rarely met with off the coasts of Wales, Cornwall, and Norfolk.)

***Cystophora cristata*. The Hooded or Bladder-nosed Seal.**

(Occasionally met with off the eastern coasts of England and Scotland, and the Orkney Islands, and off the west coast of Ireland.)

ORDER, *RODENTIA*. The RODENTS, or GNAWING MAMMALS.

SUB-ORDER, *DUPLICIDENTATA*. HARES and RABBITS.

FAMILY, *LAGOMYIDÆ*. The PIKAS.

Lagomys alpinus. The Siberian Pika.

(Extinct. Found in Southern England during Pleistocene Period.)

FAMILY, *LEPORIDÆ*. HARES and RABBITS.

***Oryctolagus cuniculus*. The Common Rabbit.**

(Probably indigenous, and not directly introduced by man. Abundant throughout England, Wales, Scotland, and Ireland.)

***Lepus timidus*. The Mountain Hare.**

(Distribution at the present day limited to Scotland, the Hebrides, and Ireland, but common in England during the Pleistocene Period.)

Lepus europæus. **The Common Hare.**

(Very common throughout England. Found also in Wales and Scotland; but of recent introduction into Scotland, and scarce in the extreme north. Absent from Ireland, from the Hebrides, and from the Scottish islands.)

SUB-ORDER, *SIMPLICIDENTATA.* RODENTS with only one pair of incisor teeth in both jaws.

FAMILY, *SCIURIDÆ.* The SQUIRRELS.

Sciurus vulgaris. **The Common Squirrel.**

(Very abundant throughout England and Wales. Less commonly met with in Ireland and Scotland.)

Spermophilus citillus. The Suslik.

(Extinct. Inhabited England during the Pleistocene Period.)

FAMILY, *CASTORIDÆ.* The BEAVERS.

Castor fiber. The Beaver.

(Extinct. Inhabited England, Wales, and Scotland from the Pleistocene Period down to relatively recent times—eighth century in England, sixteenth century in Scotland. Absent from Ireland.)

Trogontherium cuvieri. The Giant Beaver.

(Extinct. Inhabited Eastern England at the beginning of the Pleistocene Period.)

FAMILY, *GLIRIDÆ.* The DORMICE.

Muscardinus avellanarius. **The Common Dormouse.**

(Common in the south and centre of England and the south of Wales. Much scarcer in the north of England. Has never been recorded from Scotland, and is entirely absent from Ireland.)

FAMILY, *MURIDÆ.* The RATS and MICE.

Mus decumanus. **The Brown Rat.**

(Only introduced into the British Islands through the agency of man at the commencement of the eighteenth century. Now universally distributed throughout Great Britain and Ireland.)

Mus rattus. **The Black Rat.**

(Probably introduced by the agency of man into these islands in the eleventh century. At one time very abundant, but now becoming scarce. It is found in parts of Northern England, and in Scotland and Ireland.)

Mus musculus. **The Common Mouse.**

(Universally distributed throughout the British Islands.)

Mus sylvaticus. **The Long-tailed Field Mouse.**

(Five sub-species or varieties are found in the British Islands, one of which (*M. s. hirtensis*) is limited to the island of St. Kilda, and another (*M. s. hebridensis*) to the islands of Lewis and Barra in the Outer Hebrides. A third variety (*M. s. celticus*) is restricted so far as the British Islands are concerned to the south and west of Ireland, the Hebrides, and the island of Skye. A fourth variety (*M. s. wintoni*) is restricted to the southern half and the north-east of England. The fifth form (*M. s. intermedius*) is found pretty widely distributed over Great Britain and Ireland, the Isle of Man, and the Channel Islands.)

Mus minutus. **The Harvest Mouse.**

(Absent from Ireland, and its distribution mainly confined to England and Wales, together with a small portion of Eastern and Southern Scotland.)

Microtus agrestis. **The Field Vole.**

(Absent from Ireland. Common throughout Great Britain and some of the nearer Hebrides.)

Microtus amphibius. **The Water Vole.**

(Absent from Ireland, common throughout Great Britain.)

Evotomys glareolus. **The Bank Vole.**

(Absent from Ireland, and restricted in its distribution to England, Wales, and the southern half of Scotland.)

Myodes lemmus. The Lemming.

(Extinct. Inhabited England, Ireland, and possibly Wales in the Pleistocene Period.)

Cuniculus torquatus. The Banded Lemming.

(Extinct. Inhabited Southern and Eastern England in the Pleistocene Period.)

ORDER, *UNGULATA.* HOOFED MAMMALS.

SUB-ORDER, *PROBOSCIDEA.* ELEPHANTS.

FAMILY, *ELEPHANTIDÆ.*

(*Elephas meridionalis*, the Southern Elephant, and *Elephas antiquus*, both of them belonging to the African group of the True Elephants allied to *Elephas africans* at the present day, inhabited Southern England at the beginning of the Pleistocene Period.)

Elephas primigenius. The Mammoth.

(Extinct. The Mammoth was found over all England and Wales, in the southern and lowland regions of Scotland, and all over Ireland. It entered Great Britain during the Pleistocene Period, and lingered in Ireland almost to the verge of historical times.)

SUB-ORDER, *PERISSODACTYLA.* ODD-TOED UNGULATES.

FAMILY, *RHINOCEROTIDÆ.* RHINOCEROSES.

Cœlodonta [or *Diceros*] *leptorhinus.* The Slender-nosed Rhinoceros.

(Extinct. Inhabited Southern and Central England and Wales in the Pleistocene Period.)

Diceros megarhinus. The Big-nosed Rhinoceros.

(Extinct. Inhabited Southern England and South Wales in the Pleistocene Period.)

Diceros antiquitatis. The Woolly Rhinoceros.

(Extinct. Inhabited England and Wales in great abundance during the Pleistocene Period, lingering perhaps down into Prehistoric times and the advent of Neolithic man.)

FAMILY, *EQUIDÆ.* The HORSES.

Equus stenonis. Steno's Horse.

(Extinct. This was a primitive type of horse which was still existing in Eastern and perhaps Southern England at the commencement of the Pleistocene Period.)

Equus caballus. **The True Horse.**

(Exists in a domestic condition; but probably descended from the wild form in the west of Ireland, and possibly parts of England and Scotland. As a wild species the True Horse existed in enormous numbers throughout Great Britain and Ireland from the close of the Pliocene, through the Pleistocene and Prehistoric, to the Historical Period.)

SUB-ORDER, *ARTIODACTYLA.* The EVEN-TOED UNGULATES.

FAMILY, *HIPPOPOTAMIDÆ.* HIPPOPOTAMUSES.

Hippopotamus amphibius.

(Extinct. Inhabited England as far north as Yorkshire, possibly also parts of Wales. Remains of the hippopotamus are thought to have been found in Antrim caves in the north-east of Ireland. The hippopotamus lingered as an inhabitant of England to near the close of the Pleistocene Period.)

FAMILY, *SUIDÆ*. The PIGS.

[A very large pig, *Sus erymanthius*, which inhabited England during the Pliocene, may have lingered on into the Pleistocene. Its remains—which may be identical with a species variously termed *Sus antiquus*—have been obtained from the late Pliocene formations of East Anglia, together with those of *Sus palæochœrus*.]

Sus scrofa. The Wild Boar.

(Extinct. Inhabited Great Britain and Ireland through the Pleistocene and Prehistoric Periods, and only became finally extinct in Britain during the seventeenth century.)

FAMILY, *CERVIDÆ*. The DEER.

***Capreolus capræa*. The Roe Deer.**

(Formerly abundant in England, Wales, and Scotland, but now restricted as a wild species to Scotland, though reintroduced in a feral condition into England and Wales, and also imported into Ireland, of which country the Roe is not a native.)

Alces machlis. The Elk, or Moose.

(Extinct. An inhabitant of Great Britain and Ireland in the Pleistocene Period, and possibly remaining on in certain districts into Prehistoric times.)

Rangifer tarandus. The Reindeer.

(Extinct. An inhabitant of Great Britain and Ireland during the Pleistocene Period. It lingered on through the Prehistoric Period into the Historic, and probably did not become finally extinct in the north of Scotland till the eleventh century.)

***Cervus dama*. The Fallow Deer.**

(A species doubtfully indigenous to Great Britain. Fossil remains very like *Cervus dama* and others belonging to *Cervus browni* and *carnutorum*, together with *C. savini*, closely allied forms, show that Damine deer certainly inhabited Britain at the beginning of the Pleistocene Period. It is thought by some authorities that the existing *Cervus dama*, which is found in a feral condition in England and Scotland, was introduced into Great Britain either by the Romans, or by the Norman, Angevin, and Stuart kings.)

Cervus giganteus. The Megaceros, or Gigantic Deer.

(Extinct. Inhabited Great Britain and Ireland—the last country in great numbers—during the Pleistocene and Prehistoric Periods, perhaps lingering in Ireland to the verge of the Historical age.)

Cervus elaphus. **The Red Deer.**

(Still found in a wild state on Exmoor (Somerset and Devon), and perhaps in some parts of the north-west of England. Found wild in the county of Kerry (Ireland), and in the Highlands and some of the large islands of Scotland. In a feral condition this deer is common in England, Wales, and Ireland.)

FAMILY, *BOVIDÆ.* The HOLLOW-HORNED RUMINANTS.

Gazella anglica. The English Gazelle.

(Extinct. Found fossil in East Anglia.)

Saiga tatarica. The Saiga, or Swollen-nosed Gazelle.

(Extinct. Inhabited Southern England in the Pleistocene Period.)

Ovibos moschatus. The Musk Ox.

(Extinct. Inhabited Southern and Eastern England in the Pleistocene Period.)

Capra hircus. **The Common Goat.**

(Doubtful as an indigenous British species, though common as a domestic and even a feral animal. Feral goats found in Western Ireland and in Wales.)

[*Ovis savini.*

A wild sheep, possibly connected with the Armenian Mouflon. Inhabited Eastern England as late as the early Pleistocene Period.]

[***Ovis aries.*** **The Common Sheep.**

Exists throughout the British Islands as a domestic animal, and in a domestic condition it was certainly introduced. Whether or not any true wild *Ovis aries* inhabited Ireland or Great Britain is still a moot question. Remains very like what might have been the wild stock of the domestic sheep are found in Pleistocene deposits in Ireland.]

Bos priscus. The extinct European Bison.

(Extinct. An inhabitant of England as far north as Yorkshire in the early part of the Pleistocene Period.)

Bos taurus. **The Bull** (domestic and feral).

Bos taurus (*primigenius*). The Urus, or Aurochs.

(Extinct as a wild species. Inhabited Great Britain, but not Ireland, during the Pleistocene and Prehistoric Periods, lingering perhaps down to the commencement of the Historical age, when it merged into the existing breeds of feral cattle. With it may be classed *Bos taurus longifrons*, which

may have been an early domesticated race of the aurochs. *B. t. longifrons* is the origin of several breeds of domestic cattle, and its remains are found in Great Britain and Ireland.)

ORDER, *PRIMATES*. LEMURS, MONKEYS, and MAN.

FAMILY, *CERCOPITHECIDÆ*. The OLD-WORLD MONKEYS.

Macacus pliocenus. The English Macaque.

(Extinct. This species of Macaque, hardly distinguishable from the Gibraltar ape, inhabited Eastern England at the beginning of the Pleistocene Period.)

FAMILY, *HOMINIDÆ*. MANKIND.

Homo sapiens caucasicus. **The white or Caucasian race of Mankind.**

(Universally distributed over the British Islands.)

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